The problem of fatigue is one of the greatest industrial problems, and the need to fight it has never been as great as now.

And scientists ARE fighting it, and, by the time the war is won, the war against fatigue may be won too.

When that happens, we can begin to build our new world, in which the machine serves man and no longer wears him out.

A well-trained docker can toss freight all day and a woman can shop for hats without suffering any undue discomfort.

But let them change places and they would be fagged out in a short time. The point is that neither is adapted to the work of the other.

Given enough time, man can accommodate himself to almost any conditions. He lives everywhere.

Since fatigue seemed to be very largely a question of adaptation, said the scientists, why not study men as they adapted themselves to conditions as dramatic as possible?

So they have gone on expeditions to the flaming hot Black Canyon region of the Colorado River basin; and into the sweltering, tropical humidity of the Panama Canal's Gatun Lake.

They have worked in the Youngstown steel mills and in the highest permanent town in the world, a sulphur mining camp perched 17,000ft. up on Mt. Aucanquilcha, in the Andes.

They have brought back quantities of practical information. The trip to the site of the Boulder Dam construction camp will illustrate.

During the first year of construction in this sweltering rock crevice fifteen men died of heat, and scores of others had heat cramps—a malady accompanied by pains [illegible]parable only to those of childbirth.

It had been previously suggested that heat cramps and heat fatigue might be due to loss of body salt by excessive sweating. Taking this as a cue the scientists began investigating.

Science and Sweat

For hours on end workers walked on treadmills, clothed only in socks and shorts. Weighings before and after indicated the amount of sweat that had been lost; and baths in rubber tubs f
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learned to conserve salt.

Once large-scale tests had indicated the extent of salt loss it was a simple matter to remedy: by adding salt to drinking water.

After this was done workmen remained alert and fresh. Heat deaths stopped and heat cramps became rare.

As a consequence of this work, salt in drinking water is now a routine matter in hot industries; in glass making, steel, baking and even on the Detroit assembly lines.

22102048146

Med
K11762

Edith MacHutchin

Lieutenant E. H. Hotchkiss and

THE SALT OF THE EARTH.

◆

MAN?

"Express" Correspondent.

PARIS, Tuesday, Sept. 10.

Woman, according to the latest scientific conclusions, is man's inferior because of the smaller percentage of chloride of sodium in her blood. So says the "Matin" this morning.

In other words, the blood of the male is more salt than that of the female, and observation of animal life shows that the more salt there is in the blood the higher the intelligence and general development.

Woman, it is declared, is inferior to man in everything—intelligence, reason, and physical force. The indictment is even more severe. The facial angle of the female, it is stated, more closely resembles that of the higher animals than does that of the male, while woman's senses are less keen than those of man, and she feels pain less.

The scientific explanation is that the blood of the female is poorer in red corpuscles, and therefore relatively poorer in brine, which is the important factor in the development of the individual.

20 Margravine Gardens
Baron's Court W.6

ABERDEEN UNIVERSITY PRESS

CRIMINAL IS THE IGNORANCE WHICH CAUSES DISEASE AND DEATH

COMMON SALT

ITS USE AND NECESSITY FOR THE MAINTENANCE OF HEALTH AND THE PREVENTION OF DISEASE

In Sale Salus

BY

C. GODFREY GÜMPEL

FELLOW OF THE PHYSICAL SOCIETY, ASSOCIATE OF THE INSTITUTE OF CIVIL ENGINEERS, ASSOCIATE OF THE INSTITUTE OF ELECTRICAL ENGINEERS
MEMBER OF THE BRITISH ASTRONOMICAL ASSOCIATION, ETC.

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Dedicated

TO THE MEMORY OF

AN ONLY CHILD,

WHO, THROUGH HER SUFFERINGS AND HER DEATH,

WAS THE INCENTIVE

TO THE INQUIRY

RECORDED IN THESE PAGES.

"So lange die medicinische Wissenschaft nicht Volkswissenschaft geworden ist, so lange hat dieselbe ihre Aufgabe nicht erfüllt."

—Prof. Dr. RUDOLPH VIRCHOW.

"It is much our own fault that we are ill."

—Sir JOHN LUBBOCK.

"In unserer Zeit wird zuviel beobachtet und zu wenig gedacht."

—REIL.

"Die geringste objective Beschreibung wird gegenwärtig höher geschätzt, als eine richtige theoretische Ableitung."

—Dr. WILHELM ROUX.

"Les idées préconçues sont nécessaires, indispensables; on ne fonde rien sans elles; il faut savoir seulement les abandonner, lorsqu'elles n'ont plus de raison d'être."

—CLAUDE BERNARD.

TO THE READER.

BY WAY OF PREFACE.

In the following pages it is my object to acquaint you with one of the simple natural means, which can contribute to the establishment and maintenance of your health; and if you, as no doubt every one does, care for the greatest gift, which fate and your own prudence can grant you: you will probably welcome the following discourse, which I address to you as a companion, who has joined me in an inquiry into the use and the necessity of common salt for our physical well-being.

This subject should be of paramount interest to every educated, thoughtful human being, since, as Schopenhauer remarks: "Nine-tenths of our happiness depends upon health alone. With it everything is a source of pleasure; without it nothing else, whatever it may be, is enjoyable; even other personal advantages—such as a superior intellect or a happy temperament—are degraded and dwarfed for want of it. . . . Good health is by far the most important element in human happiness."[1]

And among the factors upon which your health depends the principal and proximate one is: your own treatment of your body through your habits and your mode of life. This should be the incentive to a study of the wonderful construction and working of the human organism, of the causes which disturb it, and of the means you have at your disposal for maintaining it in health and for preventing it from becoming diseased.

---

[1] Schopenhauer, *Aphorismen zur Lebensweisheit*, Leipzig, Brockhaus, 1886, p. 20. (English translation by T. Bailey Saunders, M.A., London, 1891, p. 19.)

It is generally considered that the acquirement of any knowledge about the human body demands a special superior aptitude. This is by no means the case; but that it necessitates a closer application of mental effort, than ordinary works of fiction, is undeniable. If even your means permit you to call in a doctor at every trifling ache and pain, and to hear him give you advice, which often your own knowledge and common-sense should dictate to you, still it must awaken a feeling of shame, that your education has been so deficient as to compel you, through ignorance of the simplest rules of hygiene, to hear from the doctor what must appear to him platitudes.

On the other hand, with a knowledge of physiology you will understand and appreciate the difficulties which present themselves to the honest medical adviser, into whose care you may have commended yourself, should a serious malady overtake you. Your knowledge, which will enable you to escape the grasp of the quack, will also greatly assist the anxious physician in his endeavour, to restore the harmony in the functions of your organism, without degrading himself by the adoption of deceptive means, which pander to your ignorance and credulity.

It is by the education of the public in the knowledge of the human body, that medical art will be exalted; and that the true healer of our ailments will be distinguished from that professional humdrum which, as Boerhaave said, makes it doubtful whether mankind would not have fared better, had medical science never existed. It will thus result, that the individual man, in his skill and his estimable character as a physician, will ennoble the profession, and not, as is now so much attempted, the profession the man.

It is in this light that we must accept the dictum of Professor Virchow, which I have placed as a motto at the head of this treatise; and that he, the physician and the teacher of world-wide fame, had always the noblest aim in his professional labours for aiding popular education to increased knowledge, and to higher views of the human body, is evidenced by many expressions and remarks contained in his popular lectures.[1]

Does it need a word of justification for the appearance of this treatise? Certainly not for the mind, which is alert to the events surrounding us; but it may be required for him, who lives in a state of apathy and indifference, who does not notice the daily list of sudden deaths from heart disease, syncope or apoplexy, who remains unmoved by a record of the thousands of early deaths from preventable diseases, or reads without reflection the outbreak of epidemics within our midst—phenomena, which may well cause us to exclaim: "Where are the doctors?"

The shortcomings of medical science and art are the justification for this attempt to prevent disease by dis-

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[1] Prof. Dr. R. Virchow, *Vier Reden über Leben und Kranksein*, Berlin, 1862, p. 81.

seminating the knowledge of a prophylactic agent, which applies to the human body itself and not to surrounding conditions; and which assists in making the organism immune against the attacks of extra-corporeal, as also against internal agencies in the production of disease.

In judging this question we must not confuse the art of curing disease with the various disciplines, upon which that art is, or more correctly should be, based, and the growth and development of which are often mistaken for improvements in the science of medicine—a mistake mostly made by non-medical readers, and rather fostered by the profession.[1] The progress in anatomy, physiology, pathology and animal chemistry, which is very great and deserves our fullest admiration, has led to only an infinitesimal development of therapeutics; the art of curing disease has gained very little thereby, whatever medical writers and speakers on that question may proclaim. The deaths in the ranks of the profession at ages far below the ordinary span of human life, would alone prove my point, upon which I could dilate by the enumeration of well-known names of deceased persons within the last twelve months.

Honest workers in the field of therapeutics—medical men themselves, candidly admit this. Liebig[2] expressed himself on this question in unmistakable language: "Truly," he says, "one is tempted to adopt the opinion that among the sciences, which have for their object a knowledge of nature and of her forces, medicine, as an inductive science, occupies the lowest place".

---

[1] *Odium Medicum*, reprinted from *The Times*, London, Homœopathic Publishing Company, p. 85. The remarks referred to are in a letter signed J. C. B.; they are written with an animus, which is a dishonour to the writer and to the profession to which he claims to belong. "The profession does not ennoble the man."

[2] Liebig's *Letters on Chemistry*, English ed., p. 77.

Professor von Pettenkofer declares (in relation to the clamour about the discovery of the cholera bacillus—but applicable to the question before us): "When we have found in an infectious disease the specific disease-producing micro-organism, we are not entitled to assume, that we have also found the means required for conquering the disease". And Professor F. W. Beneke[1] openly asserts that "we talk more about a scientific medicine than actually exists".

Dr. Millingen[2] lectures his brother professionals in the following words: "Notwithstanding our boasted progress in scientific pursuits, and our supposed approach to perfection, there never perhaps was a period, since the fanciful days of Paracelsus, Agrippa and van Helmont, when more deceitful and fascinating reveries were indulged in, than at the present enlightened moment, nor more ingenuity and disingenuousness displayed in seeking to give substance to a vision or overthrowing its baseless fabric".

And in his dissertation on the *Rise and Progress of Medicine* (p. 549) he confesses: "How often, in seeking to trim the expiring lamp of life, do we not extinguish the last vital spark".

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[1] Prof. F. W. Beneke, *Balneologische Briefe*, Leipzig, 1876, p. 4. It is surprising that this excellent treatise has not been made accessible to English readers through a translation. It is a fountain of practical advice which should be in the hands of every practitioner.

[2] Dr. J. G. Millingen, *Curiosities of Medical Experience*, 2nd ed., London, 1839, pp. iv. and 549.

But not every doctor can see the beam in his own eye. Dr. Kühne[1] commences an article on therapeutics with the following reflection on the presumption of the laity: "Laymen," he says, "evince a special desire to offer medical advice to their fellow-creatures, without being aware, how difficult is the formation of a therapeutic judgment. *They play with opinions*, when the question at issue is the principal foundation of human happiness, *viz.*, health." And two pages farther on he condemns the narrow view, manifested in Brown's doctrines, which divides "diseases in sthenic and asthenic; and in accordance with this division, the treatment consisting in either lowering or stimulating the patient's system. This method of cure," he continues, "is said to have cost more human lives than were lost in the French Revolution."

Surely Dr. Kühne cannot deny that this was a *play with opinions*, for the system of treatment was nothing else. But *Brown* was *not a "layman"*; he was a recognised medical practitioner of acknowledged standing, with numerous disciples.

And to crown his admonition to the laity, Dr. Kühne, on the next page, admits "the incontestable fact, that the greatest number of curable diseases recover without medical aid".

The antagonistic position which the medical profession takes up at times in relation to the public is well illustrated by the remarks, contained in a leading article of *The Lancet* in relation to the late Professor Tyndall's lecture at the Royal Institution, entitled: "Dust and Disease," in which he called attention to the presence of micro-organisms in the atmosphere, and suspected their agency in the production of disease. The writer in *The Lancet* says:[1] "It is lamentable, that an eminent public teacher, when speaking on a subject of which he can know next to nothing, should place his opinion in opposition to that, entertained by all those, who are most capable of judging".

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[1] Dr. Kühne, *Kosmos*, vol. ii., pp. 312-315.

Subsequent events have avenged this dogmatic assertion. Bacteriology and Lord Lister's present high standing in the scientific world throw a deserved light of ridicule on this shallow rebuke.

These statements are not brought forward as a display of antagonism towards the medical faculty, but in defence against the unfairness and inconsistency, with which many members of the profession treat any attempt of imparting information to the general public, unless it emanates from a medical man; and from my past experience, I do not expect to escape such treatment. Let the critic show that I am wrong in my facts, or that I have misunderstood them; or let him prove that my inferences or conclusions are erroneous or faulty, or that the information offered to the general reader is either useless or already existing in a form practically and conveniently available to the public—in that case I shall be grateful.

No one can be more conscious, than I am, of the imperfection adherent to this treatise; but the importance of the subject and the conviction that I can assist others by my advice—not only to maintain health, but even to save human life—silence any hesitation, which I might entertain, in offering the following dissertation to the public. I make no pretence to literary excellence; and sensible readers will forgive errors and shortcomings if I state, that I had to work under adverse social circumstances.

---

[1] *The Lancet*, leading article, 16th April, 1870, p. 556.

The above remarks upon the uncertainties and imperfections of medical science and art, made with the intention of inducing fair criticism, will, however, not prevent us from appreciating the great responsibility and the keen anxiety, with which the conscientious physician approaches the patient's bedside, when life and death depend upon his choice of the means to be employed; but we must at the same time protest against that exclusive treatment of any subject, appertaining to the human body, as being beyond the comprehension of the educated classes.

OUR OBJECT IS: TO PREVENT AND NOT TO CURE.

Whenever, in the following pages, disease and its treatment are touched upon, it is for the purpose of gaining information about the prevention, and how far the character of the respective malady and the treatment hitherto employed or suggested by the faculty, justify us in concluding, that the administration of sodium-chloride to the organism can contribute to maintain our health and protect us against disease.

For the non-professional reader I have, in an appendix, given the explanation of the scientific terms, which are met with in the following pages. The accentuation—either by italics or spread type—is mine, except where otherwise stated.

June, 1898.

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COMMON SALT:

ITS USE AND NECESSITY FOR THE MAINTENANCE OF HEALTH AND THE PREVENTION OF DISEASE.

CHAPTER I.

INTRODUCTION—WHAT IS THE USE OF IT?

AFTER practical experience and a closer study of the subject had forced upon me the conviction, that a judicious use of common salt is one of the principal factors for the maintenance of our health, I very naturally offered my advice to friends and even strangers to induce the adoption of so simple, hygienic a means for the prevention of disease; but, with few exceptions, I was met by the above question: What is the use of it? What does it do? which invariably led to an attempt of explaining, in some cursory conversational way, the use and necessity of sodium-chloride for the animal economy, with mostly dubious results. It is, however, not so much in response to the above request for information, but rather in consequence of my growing conviction of the vital importance of common salt for our whole physical and social life, that I make an appeal to the general public, and direct attention to a subject which concerns every one's happiness—nay his very existence.

How far I am justified in this remark the following pages will prove, although I do not conceal from myself the difficulties which meet me—on the one side, in the absence of any knowledge, or at most in a very imperfect knowledge, of the human body among the general public. I have already referred to this on a previous occasion,[1] when I declared that "even those of the so-called 'lay-world,' who pride themselves upon a higher education, are criminally ignorant (criminally—because their ignorance is often the cause of disease and even of death) about the human body and its functions".

How ready are we to blame the miller who does not understand the construction of his mill, or the weaver that of his loom, or the engineer that of his tool; yet the absence of any desire to comprehend even the plainest and most important daily functions of our own body is so evident, so glaring, that it becomes difficult to explain it. I must admit, that the information offered to the ordinary reader is of a nature not very attractive, and mostly confusing; yet there are books, such as George Henry Lewes's *Physiology of Common Life*, from which the earnest inquirer could cull many hints as a guide for keeping himself in good health. It is, however, not so easy to pick out the useful information from the many statements and facts uninteresting to the general reader.

The absence of a desire for information can be explained by assuming a mental indolence—a Denkfaulheit—which prefers to be tickled and pleased by sensational novels, dealing with vices and questionable characters, in preference to acquiring sound, healthy knowledge that can raise the mind to self-respect and to the higher ideals of life.

---

[1] *On the Natural Immunity against Cholera*, London, Williams & Norgate, 1894.

Probably there is another reason why a knowledge of his own body is not the subject of concern in the average educated person. There is a proverb so readily cited and applied, more in relation to medical—and its correlative—than to any other science, *viz.*: "A little learning is a dangerous thing". This dictum of Pope's, being mostly used as a kind of threat against medicastery, or, what sounds stronger, quackery, may have influenced many inquirers to hesitate before engaging in a closer study of their own body; although it, the proverb, should be taken to heart by none more than by the professors of the healing art, since it applies to the most learned as much as to the tyro. For the danger does not lie in the "little learning," but in the "great pretensions" about knowledge we do not possess; and well would it be for those, who so superciliously brandish about with this proverb, to remember Burns's couplet:—

> Oh, that some power the gift would gi'e us,
> Ourselves to see, as others see us.

The sway which the doctors exercise over the mass of mankind on every trifling question, and which finds its strength in the general ignorance and in a want of mental self-reliance, is another difficulty I have to meet; the more so as medical men have in many instances expressed themselves strongly against the use of salt in any shape or form, about which more anon; and in this, as in many other questions, the popular saying that "doctors differ" can find an application. When medical men have expressed their disapproval of the use of salt in unequivocal terms, we cannot be surprised that the ignorant laymen are indifferent if not opposed to the use of common salt.

And this indifference is rather strengthened when we learn, what professors of physiology, who have made it the subject of their special study—and to whom we look up for information—have said upon the question. For your own benefit I appeal to you to set aside any bias and be persuaded to a perusal of the following pages, when I have no doubt that you will give me your support in my contention : that common salt partaken of daily in measured quantity (and in a manner indicated farther on) is one of the chief factors for the maintenance of our health and the prolongation of our life.

CHAPTER II.

INDUCEMENT FOR STUDYING THE SUBJECT.

IT is quite natural that you should ask the question, how my attention was directed to the necessity and the use of common salt for the human body, about which I evince such an earnest and active enthusiasm.

To me such a question seems quite superfluous ; since, in accordance with my remarks on the general ignorance of even the best educated laymen, it answers itself : because the health of our own body is the foundation of our life and of our happiness.

Practical experience in the unsatisfactory result of orthodox medical treatment generally was the origin of it ; and I know that my experience is shared by thousands of sufferers.

Go into which family circle you will, you are sure to meet with some expression of mistrust and of want of faith in the "doctors" and in the efficacy of "legitimate" medicine, often accompanied by uncomplimentary remarks. And how far such mistrust has penetrated every rank of society and makes itself evident, can not only be observed in such incidents as the late controversy in *The Times*, designated as *Odium Medicum*, but also finds expression in Judge Bacon's reply to a poor woman, who pleaded inability to pay through illness, having been under treatment by four doctors: "Four doctors, and you have survived? Wonderful!"[1]

The immediate incentive to my study of the subject was the case of blindness in a child, which was cured by a dietetic system of treatment. The purified blood reabsorbed the impurities, which the previously impure blood had deposited in the eye. This treatment, which had been employed so effectually in the case of the Russian Prince Bariatinsky,[2] applies itself to restoring a healthy digestion by the plainest food, and by reducing the quantity of liquid taken as beverage; and to assist this abstinence from liquids—that is, to avoid producing abnormal or any thirst, salt was withheld. The child recovered the eyesight with greater visional powers than she possessed previous to the ailment, and she enjoyed excellent health. How far I was supported in the prohibition of salt I shall state farther on, when dealing with the more or less strongly expressed opinion of medical men and professors of physiology.

Two years later the child succumbed to an attack of an eruptive fever; and as I could not resist the belief that the child's susceptibility for the attack was owing to a want of salt in her system, I decided to study not only the nature of these fevers, but also and principally the general connection between common salt and the well-being of the human body.

The result of these studies relating to this latter question, pursued with intervals during the last twenty-six years, I now offer to the public with the hope that others may be benefited by the perusal of the following pages and by the advice proffered therein, accompanied by the wish that they may be induced to direct their attention and further inquiries to this important subject.

---

[1] Report in *The Weekly Budget*, 1st Jan., 1898; Proceedings in the Whitechapel County Court. See also *Family Doctor* of 18th Sept., 1897, p. 34, "Fake Surgery in Paris"; and *Family Doctor* of 11th Dec., 1897, p. 230, "When Doctors Disagree".

[2] Dr. Moritz Kypke, *Die diätetische Heilmethode*, 22te Auflage, Berlin, 1863, 1st Theil, p. 51.

CHAPTER III.

WHAT IS COMMON SALT?

WHEN advising the use of salt (a daily small dose in solution) I have frequently been met by the reply: "Oh, yes, I often take a dose of salts". Such an answer would, of course, not be given by a person whose education included an elementary knowledge of chemistry. As the following dissertation is, however, intended for those ignorant of, as well as for those acquainted with, chemical nomenclature, I must not neglect to give a distinctive description of common salt, its chemical composition, its physical characteristics, etc., so far as the elucidation of our subject requires it.

COMMON SALT, COOKING SALT, TABLE SALT, is (except when it contains impurities) a clear white crystalline substance, the appearance and taste of which are well known.

It occurs in nature as:—

ROCK SALT, *i.e.*, salt found, as the name indicates, in the form of solid rocks; and as

SEA SALT, BAY SALT, MARINE SALT, *i.e.*, salt obtained by the evaporation of sea-water, either by the sun on the sea-shore in warm latitudes, or by artificial heat.

Chemical analysis shows common salt to consist of 60 per cent. of chlorine gas and 40 per cent. of the metal sodium, hence its chemical name, chloride of sodium (also, sodium-chloride, sodic chloride, and its older designation, muriate of soda; and in chemical symbols, $NaCl$).[1]

Both constituents of salt are highly deleterious to human life; yet, when chemically combined, are harmless and absolutely necessary for its existence.

The name "salt" has been given, however, by chemists to all combinations of an acid with a metal or other radical base; so that for example—

carbonate of soda—a combination of carbonic acid with the metal sodium;
sulphate of magnesia (Epsom salts)—a combination of sulphuric acid with the metal magnesium;
phosphate of lime—a combination of phosphoric acid with the metal calcium,

and a great number of other such combinations are each called a "salt," taking the word in its more extended, in its chemical, meaning. In these pages, however, when the word "salt" occurs, it means *common salt*, *sodium-chloride.*

Salt dissolves readily in water; 100 lbs. of water, at ordinary temperature, dissolve 35 lbs. of salt, and when heated to a boiling-point only 1 or 2 lbs. more. On evaporation salt crystallises in the form of cubes. It melts at a low red heat, and can be volatilised in a hot furnace. It is not soluble in concentrated alcohol; but diluted, this latter dissolves a small percentage.

A few words must suffice to point out the immense quantity in which common salt abounds all over the globe. We find it not only in the ocean, which covers three-fourths of the earth's surface, but also in inland seas and lakes, in salt-wells, and lastly in huge solid masses as rock-salt. If coal, iron and salt are the products of the earth which form the foundation of our civilisation, then England is thrice blessed, as, besides iron and coal, she possesses large deposits of this valuable mineral.

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[1] It cannot be my object in this treatise to give a complete exposition of the chemical, physical and mineralogical facts connected with common salt; it would absorb space and your attention on subjects about which any good book on chemistry and mineralogy will give you the information, should your interest sufficiently excite your desire to learn more about it.

Not unjustly has it been declared that common salt in combination with sulphuric acid forms the basis for most, and that the most important technical industries; and the number of these latter in which salt is employed has been given as between sixty and seventy.

It is of the greatest value in agriculture as manure and for the raising of cattle and sheep. In short, of all substances which nature offers to man for his use, none can exceed in its value that of COMMON SALT.

CHAPTER IV.

THE PHYSICAL PROPERTIES OF COMMON SALT.

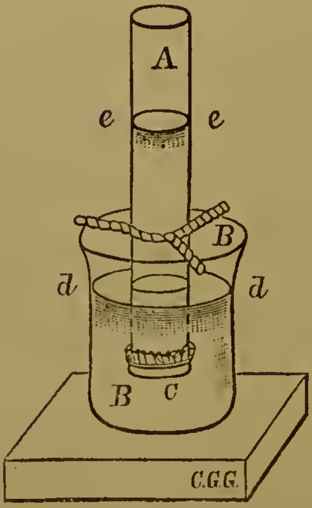
THE properties of salt in relation to organic life are of the utmost importance, and deserve a special study to enable us to understand the way, in which salt takes so conspicuous a part in many of the vital phenomena. Owing to its great solubility we shall find it, wherever water can penetrate; and by its affinity for this latter, it becomes the great instrument and agent for inducing and promoting the movement of all the liquids in the animal organism.

This interaction between common salt and the various liquids, resulting in a diffusion through animal membranes, is called dialysis; as also endosmosis and exosmosis (from the Greek—*endon*, within; *ex*, without; and *osmos*, impulsion).

A practical experiment will best illustrate this osmosmic action, to assist us in comprehending the wonderful office which salt fulfils in our body.

Let *A* in the annexed figure represent a glass tube, the lower end of which is closed by means of an animal membrane *c*. Fill this tube with water up to the height as indicated by *ee*, and then immerse it (as shown in the sketch) into another glass vessel *BB*, also containing water up to the mark *dd*. However long you may watch this arrangement, you will not discover any change in the water level in either vessel.

Next pour into the tube, in place of the plain water, a salt solution, and replace it into the larger vessel; in a very short time you will observe that the water in the tube has risen, and has done so *against gravity*, above the original height at *ee*. When at last no further change takes place, you will find the liquids in the tube and in the beaker to be equally saline.



What has taken place is an interchange; the water from the beaker has travelled through the fine interstices of the membrane into the tube, and the salt of the salt solution has passed to the water in the outer vessel. This has been effected through the great affinity between the salt and the water, the two substances meeting in the pores of the membrane.

Let us take a closer view of this phenomenon. We can easily understand, that the salt, being held in solution in the minute passages of the membrane, coming in contact with the plain water of the beaker will diffuse into this latter; but what deserves our special attention is the fact that the water from the beaker should pass into the tube against the pressure, which the column of the saline solution in the tube must exert against such a passage. This can only be the result of the affinity, which common salt possesses for the water; it cannot be explained by the capillary attraction in the interstices of the membrane.

For: if we reverse the arrangement by placing the saline solution in the outer vessel, and fill the tube with plain water, we shall observe that the latter falls in level, *i.e.*, water will leave the tube and pass to the salt in the beaker.

We can now understand Liebig's[1] remark that: "By the mere addition of common salt to the water the tube acquires the property of a pump, and sucks up the water with a force which, in many cases, is equal to the pressure of a column of mercury two or three inches in height".

"When the tube, closed by a very thin membrane, is half filled with ox-blood deprived of its fibrin, and placed in a glass of warm water (at about 100° F.), the blood after a few minutes rises just as the solution of salt did. The water flows towards the blood" (because the blood contains salt).

"The power of the membrane, to cause water to flow towards that side of it on which the salt is found, depends therefore on the salt."

Thus, then, we find common salt to fulfil an office of the highest moment for the existence of our organism; and the full extent of its utility we shall learn, when the several parts of our subject, under their respective headings, will be considered.

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[1] Liebig, p. 411. See also Liebig's *Researches on the Motion of the Juices in the Animal Body*, London, 1848.

There is one aspect of this property of common salt which it is necessary to point out, as it will facilitate a better comprehension of many important questions of the beneficial effect of salt on our body.

" Fresh flesh, over which salt has been strewed, is found, after twenty-four hours, swimming in brine, although not a drop of water has been added. The water has been yielded by the muscular fibre itself, and having dissolved the salt in immediate contact with it, it has on this account separated from the flesh. The water still retained by the flesh contains a proportionally small quantity of salt, having *that degree of dilution at which a saline fluid is capable of penetrating animal substances.*"

" This property of animal tissues is taken advantage of in domestic economy for the purpose of removing so much water from meat, that *a sufficient quantity is not left to enable it to enter into putrefaction.*" [1]

This interaction of common salt and water, even when exerted between two salt solutions of unequal degree of concentration, we shall frequently have to refer to as our subject widens out; whether it is the question of preventing the destructive action of plain water on the tissues; or the promotion of the blood and lymph circulation; or the hardening and strengthening of our muscular fibres by the abstraction of water; or the effects of salt-water *versus* fresh-water baths; in all these questions we shall find that this property of common salt is an active agent of the highest importance.

And although other mineral ingredients, such as sulphate of soda (Glauber's salts), or sulphate of magnesia (Epsom salts), and several others, are more powerful in their osmosmic action, common salt, from its special relations to most organic substances, adapts itself best for the purpose, and for promoting the interchange of mineral and organic substances in solution, upon which the growth, the nourishment and the health of our organism depend.

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[1] Liebig's *Chemistry in its Application to Agriculture and Physiology*, London, 1843, p. 356.

CHAPTER V.

SALT IN HISTORY.

WHEN directing our attention to the use of salt in relation to the human organism, the question naturally occurs: Has salt always been consumed by man as a necessary requirement for the nourishment of his body; or is this addition of salt to his food only a habit, acquired with the development of a certain amount of civilisation?

Who taught man the use of salt?

We shall not greatly err, I think, if we assume that, so far as any historical record exists or ever will come to light, the beginning of the addition of salt to food is lost in prehistoric times; and to my mind the probable answer to the last question will confirm this. It is well known that herbivorous animals will travel for miles to reach a salt-well or the sea-shore, and I find this view expressed by Dr. M. Desaive,[1] who very pertinently remarks: "Man had but to follow them". We may safely conclude that *this longing for salt existed in these animals long before our history commenced.*

That there have existed people in ancient times, as probably there are now still in the central regions of Asia or Africa, who do not add salt to their food, is more than probable; and this is explained—as we shall see farther on—by their food being almost exclusively of an animal nature. In this food they received the necessary salt required by their body; but on the whole this proves little. It can *not* convince us "that salt is *not* an absolutely necessary requirement for maintaining bodily health and strength".[1]

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[1] Dr. M. Desaive, *On the Manifold Use of Common Salt in Agriculture.* This treatise received a prize from the Academy of Medicine in Brussels. (I have only a German translation to refer to.)

Nor can Homer's reference in the *Odyssey*[2] to

> ——, a people far from the sea ——
> Who ne'er knew salt, or heard the billows roar,

prove any more, since the above remark that these people obtained the necessary supply of salt in their animal food is an answer to it.

The absolute necessity which modern researches have proved common salt to be for the life of the animal organism, makes all surmises of ancient or modern people existing without it, perfectly futile; but any opinion met with in ancient history with regard to the use of salt can serve us as evidence of the great esteem in which it was held, and the value placed upon it. And this esteem can only be the result of practical experience in the use of salt for the maintenance of health and the prevention of disease, since no industries existed at that period which could excite the people to such an enthusiastic admiration as we find expressed in their writings and their habits.

On the whole we may conclude in viewing the question about the first inducement to add salt to the food, that, with the gradual change in man's social development from the hunter and shepherd to the settled life of the tiller of the soil, the food changed from animal to a more or less vegetable diet; and that with this change arose the expressed desire for salt. The Chinese, who may be considered as the most ancient agriculturists, and hence among the earliest salt eaters, have a dim remembrance of the close connection which existed in ancient times between husbandry and salt production; both arts having a halo of sanctity attached to them.[1] I shall, on a future occasion, revert to this connection between plant food and salt consumption, when dealing with the physiological aspect of the subject.

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[1] Prof. Dr. M. J. Schleiden, *Das Salz*, Leipzig, 1875, p. 4.

[2] Homer, *Odyssey*, xi., pp. 152-3; also xxiii., pp. 285-6.

Singularly enough, this distinction between animal and plant food in relation to the addition of salt, is indirectly proved in ancient writings. Homer, who refers to no other sacrifices than those of animals, never mentions salt in connection with these sacrifices; and in ancient writings we never see salt mentioned with meat, whereas we frequently find the expressions "Flour and Salt," "Bread and Salt".

It is hence an undoubted fact that animal food among the ancients (as well as among many modern people) made the desire for salt less felt; but it does not prove that these people existed without it.

Among the Jews we find from the earliest records constant mention of salt, even in their animal sacrifices, probably owing to the circumstance that they dwelt in, and were surrounded by, regions in which salt abounded.

With reference to people living in the interior of large continents, it must be noted, what Liebig states about the evaporation of sea-water.[2] The loss of salt, he says, caused by volatilisation, "has been completely proved at the salt works at Nauheim by the very intelligent director of that establishment. He hung a plate of glass between two evaporating-houses, distant about 1200 paces from each other, and found the next morning, after the drying of the dew, that the glass was covered with crystals of salt on one or the other side, according to the direction of the wind. By the continued evaporation of the sea, its salts are spread over the surface of the earth ; and, being subsequently carried down by the rain, furnish to vegetation those salts necessary to its, as also to man's, existence." To what an enormous amount salt is thus distributed over the continents we shall have occasion to state later on.

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[1] Schleiden, p. 7.

[2] Liebig's *Agr. and Phys.*, p. 81,

It can, therefore, not be doubted that there never have existed human beings, who maintained themselves in health without partaking directly or indirectly of a certain amount of common salt ; and that even the various inhabitants of the globe, who are said not to know the use of salt, either live on the shores of the sea, or of some inland salt lake, from which the wind wafts water-vapour, laden with salt particles, over the land, and thus supplies to them, what, in their ignorance, they fail to demand for their physical health and well-being.

CHAPTER VI.

SALT IN CIVILISATION.

AMONG the millions of people who daily handle salt, how many have ever paid any attention to, or have ever formed any conception of, the unparalleled important character, which common salt has played in the history of our race?

Salt is to most people but a simple condiment, which, as such, they deign to value, but push aside as not material for their existence; whilst others look upon its use as a depraved taste and a questionable habit.

And yet wars have raged for the possession of a salt-well; the site of towns has been decided by the proximity of the mineral; and the direction of roads has been determined by the desire for an easy access to regions, where salt was found.

"How great the attraction for salt was in even prehistoric times is evidenced by some discoveries at a place called Hallstadt on the shores of the Hallstädter Sea in the Tyrol. The excavations, which were commenced in the year 1846, have exposed a very extensive deposit of human bones, the age of which is lost in the dim past—said to be 1000 years before our era."

"That man should have penetrated into this, so very inaccessible corner of the earth and settled there, can only be explained by the highly probable desire to dwell near the extensive salt deposits, which exist in the adjacent mountain-range. And archæological investigations have shown that Nauheim, Salzungen and other salt-wells, etc., have been the scenes of fierce combats for their possession. So also, at a later date, between the Burgundians and the Allemannen for the salt-wells of Kissingen." [1]

In an article in *The Times* (24th Sept., 1889), entitled "Prince Bismarck's Bath," which described the mineral baths at Kissingen, these ancient feuds are referred to in the following remarks : "It is worthy of note that not only has Kissingen been the scene of a bloody contest within living memory (between North- and South-Germans), but also that a contest, quite as sanguinary, took place here between two German tribes in days long gone by. That event found a chronicler in the greatest of Roman historians. The fight is stated to have occurred in the summer of the year 58, and the cause of it, according to Tacitus, was the right to a stream rich in salt, from which, at the present day, salt is extracted and in which patients bathe. The brine-bath which renews Prince Bismarck's strength may be derived from the stream of water, for which the struggle was so bitter in the days of old, as that of modern days has been to establish German unity."

As salt has been the cause of strife, so it has also been the means of deciding wars, and we can thus understand why the sale of salt to their enemies was punished by the Romans with death. History records that the Sellasians in the Illyrian war were forced to surrender to the Romans through want of salt ; and within our own time we find the Circassians submit to the Russians for the same reason. The French in Metz, during the siege in 1870, had to adopt a very elaborate but interesting method of manufacturing salt, to obtain for the army and the inhabitants this necessary factor for their health.

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[1] Dr. Glinzer, *Das Salz*, Hamburg, 1887, pp. 4 and 5.

The desire for salt has, however, not always led to war-like conflicts. Winwood Reade[1] relates of a tribe in Africa that it was prevented from following its favourite pastime of raiding the neighbouring tribes by the want of salt, which could only be obtained by peaceful barter; and thus, he states, through salt "isolated tribes are brought into contact with one another".

It may truly be said, that in ancient times salt influenced human society as much as gold does at present; and this view receives additional support from the fact that at the beginning and during later periods of civilisation, salt was the medium of commercial exchange as gold and silver are now.

We can estimate the high value placed upon salt throughout history by the habits, the customs and the writings among the people at all periods, from the most ancient up to the present; and on the whole we shall observe, that salt was always held in great veneration.

In the Old Testament salt appears as the emblem of eternity, of repentance, of reconciliation, of wisdom and of fidelity; this latter in the salt covenant between God and man: "It is a covenant of salt for ever before the Lord unto thee" (Numbers xviii. 19. See also Leviticus ii. 13 and 2 Chronicles xii. 5). With the Jews the salt covenant—the *melech berith*—was the most sacred obligation.

The Arabians used to conclude agreements whilst strewing salt upon bread, at the same time declaring:

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[1] Winwood Reade, *Martyrdom of Man*, p. 285.

"Peace (Salem), I am the friend of thy friend, and the enemy of thy enemy". Every oath among the Arabs is sanctified by salt, and this is the reason why salt is placed upon the table when an agreement or an alliance is desired, whereas its absence indicates the contrary.

When requesting a favour an Arab will say: "Pray do it, for the salt between us" (we have enjoyed together); hence the partaking of salt is a holy bond of friendship and fidelity of which some charming stories are told.

Djellel-eddin sent to Chazaren, who had allied himself with the former's enemy, some salt to remind him of a former friendship; Chazaren acknowledged the sanctity of his bond and came over to his old friend.

Yacub-ben-Laith, as a highwayman, entered a palace, collected some valuables, and was making his escape when he trod upon something hard. Thinking it was a jewel that had dropped out of his parcel in the hurry, he put the stone into his mouth, when he discovered, that he had tasted salt, belonging to the owner of the palace. He immediately deposited the collected booty and left the palace without it.

A merchant is surprised by an Arabian sheik in the desert; the former invites the latter to sit down to a meal, at the end of which the sheik discovers, that a salt-cellar stands near him, whereupon he at once admits: "I have accepted your hospitality and have eaten with you in the presence of salt; I must not appropriate anything belonging to you".

This symbol of holiness, attaching to salt, we meet also among the Greeks. Already Archilochus (700 years before our era) uses the expression :—

Thou hast broken the great oath,
Hast disgraced salt and table.

"Salt is the symbol of friendship," says Eustathius in his commentary to Homer's *Ilias;* "and," he continues, "it is considered as such either because it is offered to the guest before all other food, or because the idea of friendship is constancy and permanence, two qualities which salt imparts to other substances."[1]

Among many allusions to salt as the symbol of uprightness, Demosthenes, in one of his orations, uses the expression : "Who of the two has transgressed the salt and the agreement ?"[2]

Homer applied the term "divine" to it: "He besprinkled the meat with *divine salt*"; and Pythagoras calls it a substance dear to the gods, and looked upon it as the symbol of righteousness, as it preserves what it penetrates. He also considers a table not properly laid without salt. Aristotle mentions the proverbial bushel of salt as an indication of proved, lasting friendship.

Plutarch calls salt the condiment of all condiments and the most pleasant, to which he adds, that bread is all the better for containing salt, and thus bread and salt alone suffice to maintain human life.

Numa the Etruscan repeated the precept of Moses : "Do not speak of the Deity without fire, nor sacrifice without salt".

Pliny even asserts that it is impossible to lead a decent human life without salt, and he considers the *sun and salt* as the most necessary and the most precious things in the world.[3]

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[1] Victor Hehn, *Das Salz*, "Eine Kultur Historische Studie," Berlin, 1873, p. 8.

[2] *Ibid.*, p. 9.

[3] For most of these statements I must refer to the following works : Schleiden, *Das Salz*, and Hehn, *Das Salz*, both already mentioned. Besides these, Prof. Dr. G. Bunge, in *Zeitschrift für Biologie*, vol. x., p.

We can easily understand how the attachment and fidelity of a servant is designated by the words, "he eats my salt"; and in India, "I eat his salt" is equivalent to saying, "I am in his service"; while a faithless servant is called *Nemeck-haran*, that is salt-faithless.

Even the Battas—a savage tribe of Sumatra—hold salt of so much importance and as so vital an object, that they make their solemn declaration at legal proceedings by the formula: "That my harvest may spoil, my cattle die, and I never eat salt any more, if I do not speak the truth".

In Russia exists an ancient custom of entering a new house for the first time with bread and salt, and this is specially observed in the case of newly-married couples.

The most expressive manner in which the municipality of St. Petersburg could evince the sentiment of friendship for the President of the Free French Republic during his visit to the Autocrat of all the Russias was: by offering him bread and salt. The same ceremony is observed towards the Tzar, when he visits a city or town in his dominions. Salt in this latter case is the symbol of submission—perhaps more correctly of fidelity of a servant; in this view it would have been more appropriate had the French nation made such an offering to their Emperor-Tzar.

Not only salt, but also the *salt-cellar* was held in veneration by the ancient Romans. The nimbus of holiness, which attached to the mineral, was extended to

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111 *et seq.*, entitled, "Ethnologischer Nachtrag zur Abhandlung über die Bedeutung des Kochsalzes und das Verhalten der Kali-salze im menschlichen Organismus". See same *Zeitschrift*, vol. ix., p. 104. Further, Dr. Alfred Schmidt, *Das Salz*, Leipzig, 1874, and Dr. Ludewig Meyn, *Das Salz*, Leipzig, 1857, etc.

the salinum, which formed the family link between successive generations as an heirloom.

The salt-cellar had to be pure like the salt it contained ; it sanctified the table, as did the *patella deorum* in which the sacrifice was offered to the goddess Vesta. Everything else in the house might be renewed, but the salinum was inherited from generation to generation ; and however poor the other furniture might be, the occupier of a modest cottage would keep a salinum of bright silver. Only the absolute povery-stricken Roman was satisfied, at Horace's time, with a three-legged table and his salt in a shell from the sea-shore.

(Sit mihi mensa tripes, et concha salis puri.)

That the holy salt, which gave solemnity to the family meal or to the intercourse with friends, should also possess *healing* powers it was very natural to suppose. Since it could preserve the dead organic body from decomposition, it must possess a power or principle of life.

Nothing is more wholesome (healing) says a proverb of Roman physicians, than *salt and the sun.* (Pliny, xxxi., 102 : "Totis corporibus nihil esse utilius sale et sole.")

In later times, before a rational science of physiology had been established, all therapeutic (healing) powers were declared to be contained in the three substances—salt, sulphur and mercury (?).

Mr. Manley[1] gives us some interesting information on the customs in England in past times. The expression "sitting above and below the salt," is familiar. The time-honoured custom in great families of placing a massive piece of plate, called the salt-vat, on the middle of the table was one that formerly obtained in France, as also in England and Scotland, the guests being seated above or below the vessel, according to their several ranks.

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[1] J. J. Manley, M.A., *Salt, and other Condiments*, London, 1884, p. 97.

> Thou art a carle of mean degree ;
> Ye salt doth stand twain me and thee,

says an old ballad.

Proverbs, sayings and metaphorical expressions connected with common salt are found in our own and other languages. The expression " not worth his salt " had its origin probably in the word "salarium," the salt ration or salt money of the Roman soldiers. The Germans call salt the "gift of God," and have the expressive proverb :—

> Salz und Brod
> Macht die Wangen roth.
> (Salt and bread make the cheeks red.)

A significant meaning is conveyed in the words of the New Testament : " Ye are the salt of the earth " (to preserve mankind from corruption ?).

As salt was used to make food tasty, so the name was applied to indicate wit and wisdom, *sal sapientiæ ;* and the term " Attic salt " is still used to designate smart and wise sayings.

On the whole, then, the history of human civilisation gives overwhelming evidence of the great value which was placed upon salt, and this must have originated in the conviction that it was an absolutely necessary factor for the health and well-being of mankind.

CHAPTER VII.

DISTRIBUTION OF SALT.

FROM its great solubility, as already stated, we can readily comprehend that salt is found wherever water can penetrate. Hence it is distributed all over the globe, and is contained in all plants and animals, although in some of them in very minute quantities. Yet it is surprising how even infinitesimal quantities amount to enormous masses, when estimated over larger areas and extent of time.

The manager of some salt works in Germany, named Brandes, has proved by experiment that on one German square mile more than 1,000,000 lbs. of salt are deposited by the rain during a twelvemonth; equal to about 50,000 lbs. of salt on one English square mile (reckoning 1 German equal to 21 English square miles). This salt unquestionably had its origin in the sea, whence by evaporation of the sea-water it was carried along with the latter over the land and deposited with the rain.

Thus we find it distributed throughout nature in varying quantities, from the minutest "traces" in river- and well-water, to the densest brine of the Dead and other inland seas in which life is absolutely impossible; hence the adjective "dead".

And in accordance with this degree of saltness of water or of the soil, to that extent do we find plant as also animal life influenced.

In minute quantity, the presence of salt in the soil is harmful to very few, if any, plants; but when it exists in easily ascertainable proportions, we find that only a certain class of vegetation can thrive. We meet with this class of plants on the shores of inland lakes or of the sea; the former for example in the interior of Australia, where evidently an ancient salt-lake has left behind by evaporation a soil highly charged with the mineral. On the ground which formerly was the shore of this lake, and in which the salt is found in smaller proportions than in the old lake-bottom, a vegetation exists, which is known as the "salt-bush". I shall have to refer to this again later on.

That some plants prefer the shores of the salt ocean is illustrated by the cocoa-nut palm, which grows most luxuriantly in proximity of the sea. *But what can exceed the abundance and the beauty of the flora at the bottom of the salt ocean?* Proof enough, that salt even at the density in which it exists in sea-water, promotes plant life, although when present in still larger proportion it is not favourable, but more or less destructive to organic vitality; hence the use of salt for destroying vegetation where not wanted.

The presence and the influence of common salt in the bodies of the mammalia of the higher type, will be the subject of fuller inquiry in the following pages; for, whatever in this respect applies to the human body, finds also application to the vertebrates. And here again we shall meet with the distinction between the carnivora and the herbivora—the former have no desire for salt, as they receive it when devouring the bodies of the latter. These, the herbivora, show, however, a strong salt hunger; they will travel miles to get to salt; and the hunter, knowing their need of this mineral, will entice them by a salt-lick to bring them within range of his gun. Could these animals speak, they would tell us what Mungo Park stated as his experience: "The constant use of vegetable food excites a painful longing for salt, which it is difficult to describe"; and this brings us to the chief object of our inquiry, namely: common salt in the human body.

CHAPTER VIII.

SALT IN THE HUMAN BODY.

It is a singular fact, which must excite our astonishment, that in face of the great importance, nay, the absolute necessity of common salt for the existence of the human body, this subject has not been pressed more upon popular attention.

If we consult the ordinary books on physiology we are informed, that salt is a condiment, and at most it is declared to be one of the inorganic constituents of the animal economy, such statement being made merely to satisfy the demand for a scientific completeness of the treatise, without a word being said about the absolute necessity of salt for our physical existence.

And works on hygiene ignore the subject altogether, although we shall find, as our inquiry advances, that there is no question which can affect public health to a greater extent than the consumption of common salt—here, of course, not in its industrial or social aspect, but simply in its character as a food.

The general public entertains the idea, that our body requires only organic substances for its sustenance, and that beyond the building up of our osseous frame, inorganic matter is not needed, or is at most not essential. This dogma has been paraded about by the vegetarians, and is left uncontradicted or uncorrected by medical men.

It must naturally cause astonishment when we are informed, that "animals fed with food, from which all mineral (*i.e.*, inorganic) substances have been extracted, die much quicker than when food has been altogether withheld".[1]

A series of careful experiments were undertaken by Prof. Forster[2] upon a number of animals to thoroughly test the question about the necessity of the various "salts" for the life of the animal organism, the result being in accordance with Liebig's doctrine: "that albumen is enabled to change into blood-plasma and thence ultimately into parts of the body only in the presence of these 'salts'. When these latter are absent, then food becomes either indigestible or loses the capability of forming blood and tissues. Any kind of nutriment without the corresponding 'salts' is for the nourishment of the organism as useless as stones." And Prof. Forster arrives at the following conclusions:—

"The animal organism, when it is, with regard to its nutrition, in equilibrium, demands for its maintenance a supply of certain 'salts' (such as phosphate of lime, phosphate of potash, chlorate of potassium, as well as chloride of sodium and the metal iron); if this supply is reduced below a certain limit, or if it ceases altogether, then the body still continues to excrete these various 'salts' and perishes" (p. 338).

This incontestable fact answers two important questions: It shows first, that mineral substances are absolutely necessary *as food* for the support of our body, and are *not incidental constituents;* and secondly, what is also of the greatest importance, that the body loses these "salts" constantly, even though they are withheld in the food. This indicates, that in the various processes, the aggregate of which forms the vitality of our organism, these inorganic ingredients perform an essential office; they accompany the organic substances in all their changes through the body, are expelled with them, and that they hence require a constant renewal with our food.

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[1] Prof. Dr. G. Bunge, *Lehrbuch der Physiologischen und Pathologischen Chemie*, Dritte Auflage, Leipzig, 1894, p. 104.

[2] Prof. Dr. J. Forster, *Z. für Biologie*, v. ix., p. 297 *et seq.*

We can thus estimate Liebig's declaration[1] that "It does not require much chemical knowledge to perceive, that the discovery of the law, which regulates the *dependence of the quality and function of the blood on the nature and amount of its incombustible constituents, is the foundation-stone of medicine and physiology*, and that it is utterly absurd even to dream of a rational science of medicine, before we have laid this foundation-stone, on which must rest the solution of all questions concerning the animal economy".

The above remarks, which refer to all the inorganic constituents of our body, will apply in every way to common salt alone; and as we extend our inquiry, we shall learn that this "salt," which "in quantity usually amounts to upwards of one half of the total weight of the incombustible substances in the blood,"[2] exerts a most important influence directly and indirectly on all the various functions of our organism.

"It occurs in every part of the human frame; it is organised in the solids and dissolved in the fluids; it creeps into every crevice of the body, and plays a part in all the complicated processes of life, without which the machinery would be arrested in its operation."[1]

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[1] Liebig's *Letters on Chem.*, p. 397.

[2] *Ibid.*, p. 404.

"The importance of chloride of sodium in the metamorphosis of the animal tissues is illustrated by the fact, that it always forms the greatest part of the soluble constituents of all animal substances."

It is very constantly associated with animal matter, and essentially influences their chemical and physical properties, thus:—

"*Albumen in part owes its solubility to the chloride of sodium contained in it;*

"It, *chloride of sodium*, *dissolves pure casein and has a singular* POWER OF IMPEDING THE COAGULATION OF THE FIBRIN OF THE BLOOD."[2]

"In the whole muscular system, in the juice of the flesh, an abundant quantity of chlorine is found, combined with potassium," but "this chlorine is derived from common salt".

"It serves in fact in the organism to assist and promote the most universal changes."[3]

But Liebig, when declaring that it does not take a share, by its elements, in the formative process, seems to contradict himself, as he has just stated that one of its constituents, chlorine, enters into the composition of muscle; and he overlooks the fact, as pointed out by Moleschott, that, as chloride of potassium is required for the formation of muscle, and phosphate of lime for the formation of bone, so *chloride of sodium* is a necessary ingredient in the constitution of *cartilage*.

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[1] Muspratt's *Chemistry*, vol. ii., p. 897.

[2] Prof. C. G. Lehmann, *Physiological Chemistry*, London, 1851 (Cavendish Society), vol. i., p. 430.

[3] Liebig's *Letters on Chem.*, pp. 405-6.

Common salt appears to be necessary for all cell-formation, and its presence imparts strength to all connective tissue, to all bands, ligaments and tendons which hold—or as the popular saying is, knit—the body together. Hence Moleschott justly designates common salt as *cartilage salt*.[1]

On the general influence which salt has on the metamorphosis of the whole organism, extensive experiments have been made, especially by Prof. Voit, of Munich, who arrived at the following conclusions :—[2]

The effect of common salt on the general metamorphosis of matter in the human body can be stated as follows :—

1. "Common salt, by virtue of its physical properties, augments the circulation of the various juices in the organism, increases the oxidation of albumen and thus the quantity of urea," *i.e.*, processes upon which the health of our body depends.

2. "To eliminate the salt from our system water is required ; this water is taken from the various organs of the body, and from that, which would otherwise be exhaled as vapour, by the lungs. Common salt is hence a diuretic."

Prof. Voit concludes the account of his researches by the following remarks, which well express the true office fulfilled by sodium-chloride in the animal economy :—

"A chief condition for the production of the vital phenomena as the result of the interaction of the different substances in the organism is : *the constant flow of*

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[1] Prof. Jacob Moleschott, *Kreislauf des Lebens*, "Antwort auf Liebig's Chemische Briefe," Vierte Auflage, Mainz, 1863, pp. 159-60.

[2] Prof. Dr. Carl Voit, *Untersuchungen über den Einfluss des Kochsalzes auf den Stoff-wechsel*, München, 1860, pp. 65-6.

the various fluids through the tissues. When this flow ceases then life becomes extinct. This flow is the result of the molecular attraction of the separate particles, and is intensified by the presence of common salt in a manner, as we observe outside the human body, in the osmosmic experiment with albumen and water."

"It is the office and function of common salt in the body to regulate this flow in its intensity; more salt produces a quicker current and an increased oxidation of albumen." In other words, *increased vitality.*

We will now direct our attention to the individual organs in relation to the many offices, which common salt has to fulfil in our body; and in this we shall commence with the most important of all, *viz.*, salt in the blood.

CHAPTER IX.

THE BLOOD.

Blood is in popular language synonymous with *Life;* hence we speak of our Life's blood; and with truth does George Henry Lewes[1] call blood "*a mighty river of life*".

Moses, as also some Greek writers (Empedocles), considered it as the seat of the soul; while Critias (a disciple of Socrates) as the soul itself; and Mephistopheles tells Faust that "*Blood is a very peculiar juice*".

Unquestionably: on the healthy condition, the purity and vitality of the blood depend our physical well-being, our bodily strength, our mental sanity and the happiness of our existence. And of all the constituents of this very peculiar juice, *there is none, which can possibly surpass common salt in its necessity for a strong healthy blood.*

To prove my contention I have to claim your patience for an exposition of the character, the composition and the function of our life's blood; but this truly grand subject would deserve, even for the "unlearned laity," an extensive treatise, such is its importance and the great interest it must naturally excite.

For the purpose of the question before us I must, however, confine myself to an explanation of those points only which bear either directly or indirectly upon the influence and the action of common salt in the blood.

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[1] George Henry Lewes, *Physiology of Common Life*, 1859, vol. i., p. 239.

It is, however, prudent to state here, that the whole question of the life and function of the blood in the animal organism is still surrounded with a great deal of mystery; that little is positively known in comparison to what we wish to know; but that most facts are determined by inference and by deduction. We can make tolerably sure that certain phenomena will happen; we know the conditions and circumstances under which they occur, but we are unable to explain the cause and the *modus operandi.* And this applies in greater part to almost all the phenomena of organic life.

We need not go so far as to declare, that the life of the human body is centred in the blood; but it is not less true when we say that the blood forms the basis of our existence. It permeates the whole body; it supplies the material for the growth and the maintenance of every part and enables the various organs to perform their functions.

It does so, however, while in constant flow from the heart through the arteries, the capillaries and veins back to the heart. Arrest this flow and life becomes extinct. In its course it takes up the digested food and carries this to the liver, there to submit it to a process of selection, to form new blood as also new compounds for the nourishment of the nervous system. Then it enters the heart to be thence sent into the lungs for the absorption of oxygen from the inhaled atmospheric air, and returns once more to the heart.

Furnished thus with the necessary material, it is now despatched on its journey through the body to nourish this latter; to the brain it carries the oxygen and food to the nerve-centres, and thus ensures our mental activity and our consciousness; to the various muscles and organs it supplies the food as also the oxygen, through the interaction of which all physical energy is produced.

But it also takes up in its course all used-up, effete matter, all waste and retrogressive material; carries these to the kidneys, the intestines, the skin and the lungs for their elimination out of the body; and thus the blood flows continuously through the system during the whole period of our individual existence.

From this short sketch it will be evident that the blood in its course is not and cannot possibly remain the same in its composition, but that it changes considerably in its constituents while passing through the various parts of the body.

From careful observations and experiments, it has been ascertained that it takes about a half to one minute for any portion of the blood to complete the entire circulation.[1] (Hermann gives twenty-three seconds.)

In its general character we may describe blood as consisting of a liquid, the "plasma"—liquor sanguinis; and of the "blood corpuscles," very minute bodies floating in the plasma. These corpuscles, sometimes called "cells" (or as George Henry Lewes with some reason prefers, "discs"), are so small that only a high magnifying power of the microscope can reveal them to us; their diameter is estimated at $\frac{1}{3000}$th to $\frac{1}{4000}$th, and their thickness at $\frac{1}{10000}$th of an inch. They were at one time considered as true cells, consisting of a membranous covering, enclosing a more or less fluid substance; later researches, however, have proved each to be a lump of protoplasm, without any investing membrane, but formed like a sponge with innumerable cellular interstices. They are thus able to absorb the plasma or liquid in which they float. The shape of a blood corpuscle *in its healthy normal state,* may be described as a disc with rounded edge, the central part of each surface being slightly concave as illustrated in the annexed figure, which represents such a disc highly magnified, showing the central form in section.

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[1] Hermann's *Elements of Human Physiology*, London, 1875, p. 71. See also Kirkes' *Handbook of Physiology*, 8th ed., London, 1872, p. 178.

These corpuscles being red, give to the blood its colour. They are soft, ductile and elastic ; and *in their normal shape* (I lay stress on this normal condition as of great importance in relation to health and disease, and to the office which salt has to fulfil in the blood) accommodate themselves by elongation to the smallest capillary in their passage through the tissues of the body ; but they resume their disc form when arriving in the more spacious vein.

The frame or body of the corpuscles—the " stroma "—is of a colourless structure, and is infiltrated throughout by a red colouring matter called hæmoglobin, an albuminous compound containing iron. This hæmoglobin gives to the corpuscles the power to perform their chief, if not their only, function, which is, during their passage through the fine capillaries of the lungs, to absorb from the inhaled atmospheric air the oxygen, and carry this latter to the various parts of the body for the use of the respective organs ; to the brain to *excite to mental activity ;* to the *heart to stimulate the nerve-centres in that organ,* by which its pulsations are maintained ; to the muscles to give them the means for physical exertion ; to the various other parts and organs to oxidise used-up matter and so prevent the formation of poisonous germs and substances, which may endanger our health and ultimately life itself; and lastly to serve for the production of animal heat—as the exact maintenance of our body's temperature, within very narrow limits, is one of the necessary conditions of life.

From the very first moment of our existence until the last flicker of life leaves our body—in its first development and growth, in its activity in middle life, and at the decline of our strength—it is oxygen that is a principal factor in all the vital phenomena. Without oxygen there is death in the whole or in part of the body; hence *the maintenance of health and life depends upon the normal condition of the red blood corpuscles.*

Besides the red, the blood also contains white corpuscles; these are, however, of an irregular shape, rather larger than the red, and considerably less in number. In health there may be 1 white to 400 or 500 red corpuscles, but in disease the proportion is often as high as 1 to 10, and sometimes even much higher.[1]

The white corpuscles may be considered as a transitory state in the conversion of food into blood; but in this aspect they assume for us an important character, as they supply, in many forms of disease, the pabulum for the morbid products; and their presence in abnormal quantities would point to an irregularity in the digestive and assimilative process, and indicate a retardation in the formation of new red corpuscles; both being processes which are beneficently influenced by, and to a great extent dependent upon, the presence of common salt in the system.

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[1] Kirkes' *Physiology*, p. 76.

CHAPTER X.

SALT IN THE BLOOD.

A FEW words must suffice to describe the nature and composition of the liquor sanguinis, called the blood "plasma," from the fact, that it contains the "plastic" material for building up and replacing the used-up substances of the body.

When the blood is freed from the red corpuscles and from the fibrin, the remaining liquid is called the "serum" of the blood, a term which attracts attention by its indication of the latest therapeutic fashion, in vogue among medical men, for the cure of several infectious and non-infectious diseases.

The liquor sanguinis consists of about 90 per cent. of water, holding in solution various albuminoid substances: albumen, fibrin and casein, besides some other highly organised compounds, which, as just stated, supply the food for the growth and maintenance of the tissues and organs.

The liquor sanguinis—in short the "serum"—also contains a number of complex ingredients and retrogressive or waste substances, the slag (as the result of the metamorphosis of the tissues), such as urea and uric acid, which are on their way to the secretory organs for expulsion from the system, and about which we shall have to learn something later on. And lastly, the serum contains a certain quantity of "salts" of various kinds, the chief of which, "sodium-chloride," will now require our attention that we may learn the important office which this salt has to fulfil in the blood, principally for maintaining the corpuscles in their normal condition, but also to protect the blood plasma against abnormal changes.

I cannot introduce this subject better and more impressively than by citing a portion of a lecture of Prof. Burdon-Sanderson, which deals with the examination of the circulation of the blood in the membranes of a living animal under the microscope. He says:[1] "The observations, hitherto made on the mammalian mesentery, have been without practical results, the reason being that so vulnerable a tissue as that of the peritoneum, cannot be exposed for a few minutes without injury; so that, although the greatest care is taken in demonstration, only a momentary glimpse can be obtained. To obviate this difficulty, the arrangements for placing the membrane under the microscope must be of such a nature, that the structure (the fine membrane) is bathed during the whole period of observation in a liquid of the temperature of the body. I need not tell you, after what you have learned of *the destructive influence of water on the living tissues*, that that liquid would not answer the purpose. Serum would probably be best (for the reason that it contains sodium-chloride) if it were always at hand, but practically a solution of common salt of the strength ordinarily used ($\frac{3}{4}$ per cent.) answers the purpose perfectly."

What must strike the ordinary reader in this statement with astonishment is the professor's remark about "the destructive influence of water on the living tissues". Water, the most essential element of all organic life—"*innocent water*"—to have *destructive influence on living tissues?* Yet, so it is, as every one can ascertain for himself if possessed of a good microscope, by the following simple experiment :—

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[1] *Medical Times and Gazette*, 6th May, 1871, p. 506.

Prick your finger with a needle, press out a drop of blood, and place this on a glass slide under the microscope. With an objective of sufficient power you will distinguish the blood corpuscles of a shape as shown on page 40, provided your blood is in a healthy condition. Add to this drop of blood a drop of pure water and you can observe the blood corpuscles to swell; their biconcave shape disappears and they gradually assume a spherical form, which is declared by Klebs[1] to be *an indication of death.* A continued absorption of water will cause the corpuscles even *to burst and to diffuse their hæmoglobin and their potash salts in the liquid in which they float.*

If, now, before such destruction takes place, a grain of common salt is added to the watery blood we can actually see the globules gradually restored to their normal form, *i.e.*, those blood globules, which have not been killed by the absorbed water, will give up this water to the salt solution. In those globules, in which the distension has gone too far, no alteration takes place; *they are dead and of no further use as carriers of oxygen* to maintain the life of the organism, and we shall see farther on, that these dead globules and the diffusion of the potash salts in the blood-serum unquestionably endanger life by their action on the heart.

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[1] Dr. L. Hermann's *Handbuch der Physiologie*, 6 vols., Leipzig, 1879-1881, . . . vol. iv.a, p. 19. (From *Centralblatt f. d. med.*, Wiss., 1863, p. 851.)

At first sight, this deleterious action of water on the life of the blood corpuscles (I do not assert too much by adding, and thus on the life of the organism) would look most alarming, as it might appear that it would with facility be possible to destroy the blood and human life with "innocent water"; but this fear will be allayed when we know, that the blood always contains a certain quantity of common salt to prevent such destruction—at all events the immediate destruction of the whole quantity of the blood.

It will now be our object to ascertain, how much salt is contained in the blood, how it exists, whether in combination or not, and how and to what extent it can be increased or diminished in proportionate amount.

CHAPTER XI.

QUANTITY OF SALT IN THE BLOOD.

We need not concern ourselves, for the present at all events, with the quantity of the mineral ingredients contained in the blood corpuscles, as the iron and the potash salts are found in the hæmoglobin in definite proportions and thus fluctuate with the amount of corpuscles in the blood. The sodium-chloride contained in the serum varies, however, within certain ascertained limits, above which it is never found, and below which it sinks only in cases of disease, and this limit is independent of the nature and character of the food.

The proportion of salt found in the blood by numerous experimenters is stated to be from 2·5 to 6 per 1000 parts of blood. It is a remarkable fact, that although this proportion can vary within these limits (considerably more than 1 to 2), this great difference is never or seldom referred to when the constitution of the blood, in relation to its functions or to health and disease, comes in question; and yet, as we shall see, it is of the utmost importance whether the blood contains common salt in the proportion of 2·5 or 6 per 1000. When doctors are speaking of diseases which are directly traceable to a disturbed condition of the blood, it is always assumed, that the amount of sodium-chloride is a fixed, definite, proportionate quantity; its diminution is never taken into consideration, although of such vital importance.

Nevertheless its great fluctuation is admitted. "By the prolonged use of food, rich in common salt, the blood becomes richer in saline constituents, and especially so in chloride of sodium" (Lehmann[1]); and we shall learn that it will account for many phenomena which appear occult or inexplicable.

Lehmann[2] cites the following results of various investigations: "Berzelius found 6 parts in 1000 of the serum of human blood, and Marcet 6·6 in 1000 parts of blood, which corresponds to about 5·5 in 1000 of serum. Nasse obtained 4 to 5, Denis 3·5 to 3·6, and Becquerel and Rodier from 2·3 to 4·2 parts per 1000."

It is necessary to call special attention to this, what, in face of the vital importance of its sufficiency in the blood, may be called an enormous difference, which, as we shall see, may well excite our alarm.

The actual quantity of salt in the blood within the above limits is naturally dependent on the amount taken with our food or otherwise supplied to the system; but it cannot exceed the higher proportion, owing to the function of the kidneys, which eliminate from the system not only abnormal, but also most necessary constituents of the blood, whenever these are present in superfluous quantity.

This limit would seem to be, as already stated, 6 per 1000, which was found by Nasse as that density of common salt solution *least harmful to the blood and the tissues generally.*

It is necessary to know that the tissues as well as the blood-serum absorb sodium-chloride, which would naturally follow from the great diffusibility of salt solution.

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[1] Lehmann, vol. ii.. pp. 251-2. [2] *Ibid.*, vol. i., p. 431.

In fact, all the tissues of our body are, or should be, bathed in liquids, containing sodium-chloride, more or less approaching the proportion in which it is contained in the blood. We dare not omit to remember this fact, as it will greatly assist us in the attempt to explain the many phenomena of health and disease.

When salt is added to our food, whilst the quantity (the proportion) in our blood has not reached its maximum, we shall find by comparing the amount taken with the amount excreted, that the salt is retained in the body; but as soon as this maximum is reached, we shall discover, that the quantity, taken in twenty-four hours, is eliminated again in that period.

Similar phenomena, but of course opposite in their nature, we meet with when inquiring into the minimum amount of salt below which the blood will, under normal conditions, not part with it. Whether this is also the case with regard to the tissues, I have not been able to find any investigations reported or opinions expressed; but for reasons, which I shall state when dealing with this subject under other headings, I doubt whether this tenacity of retaining common salt, possessed by the blood, is shared by the tissues.

Upon withholding salt from the system we shall first notice, that the kidneys still continue to excrete salt; this is, however, not taken from the blood alone, provided, of course, that the amount of the salt in the blood has not reached its minimum limit. Whatever salt the blood loses, is partly given up by the tissues, so that blood and tissues join in supplying the kidneys with the salt required for excretion. This process continues at a gradually reduced rate until no more common salt can be discovered in the urine.

The amount of this indispensable constituent of the blood has then reached its minimum, beyond which the blood does not part with it; a further loss is death to the blood in proportionate quantity. Becquerel and Rodier,[1] who call attention to the absence of any instance in which the amount exceeds the maximum, declare that: "Sa diminution, au contraire est un fait constant *sous l'influence de la diète.* Ainsi, dans les maladies aiguës, considérées d'une manière générale, et en rassemblant tous les faits que nous avons recueillis, on a pour moyenne 2·5, et pour variations 2·0 et 3·0 comme minimum et maximum. Ces chiffres montrent que *la diminution de ce principe est assez considérable;* elle est manifestement due a l'absence de nourriture et au manque d'introduction du chlorure de sodium dans l'organism."

"Les recherches de M. Mialhé ont confirmé complètement les nôtres et ont démontré la diminution de proportion de chlorure de sodium dans les maladies en général."

The question could not be stated clearer. What concerns us as of most importance, and which we should never have absent from our minds in the further investigation of the main question before us, is the fact that, by withholding entirely from salt, or by taking it in reduced quantity, or by washing it out of the blood by immoderate imbibing of liquids, we can reduce the quantity of salt in the blood to such a minimum that, by a further reduction (or by addition of water), we endanger the life of the blood.

Let us for illustration's sake assume, that the blood has been deprived of its common salt to that degree, that 1000 parts of the serum contain 2·50 parts of salt, and that this is the minimum, below which the constitution of the blood is liable to suffer. If now, to make the case more comprehensive, we add 100 parts of water to the blood, we reduce the proportion of salt to 2·27 per 1000. It is evident, therefore, that, by adding water to the blood, we reduce the relative quantity of salt.

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[1] Becquerel et Rodier, *Chimie Pathologique*, Paris, 1854, pp. 65-6.

This reduction in the proportion will have no further effect on the excretion of salt, as the blood tenaciously retains this minimum quantity; but the effect upon the blood corpuscles cannot be neglected. Although the kidneys eliminate the superfluous water as they expel superfluous salt, yet the water must have been absorbed by the blood and been conveyed to the kidneys, and in this passage through the blood it can and does unquestionably destroy the corpuscles of the blood; it may be only in minute quantity, which, however, by repetition, would soon assume a dangerous character. Corpuscles once destroyed cannot be resuscitated, however much sodium-chloride we may introduce into the system.

The portion of blood, thus destroyed, circulates with the other blood through the vascular system, but it is useless for the proper vital functions of the blood; it cannot absorb oxygen, and without this, it is the cause of many diseases, which manifest themselves in various forms.

On the absorption of watery blood-serum by the corpuscles, experiments have been made by many physiologists, the result being that "the affinity of the red blood corpuscles for water depends upon the quantity of common salt in the blood, and is normal when the latter is normal. *If the latter is lowered, then the absorption of water augments.* The solution of salt, which is isotonic with the blood-serum, is the so-called 'normal saline solution,' *i.e.*, the solution which is least harmful to the blood corpuscles and to the tissues of the body."[1]

As already stated, Nasse[2] found the most favourable proportion of the solution to be 0·6 per cent.; and this, named in England "*the normal saline solution*," has received in Germany the name of "physiological water," and in France, "artificial serum".

As we proceed in our inquiry we shall find, that many symptoms of disease can be accounted for by this partial destruction of the blood (in larger or smaller quantity); but for the present let me repeat the principal facts brought to our knowledge in the preceding pages.

1. Blood corpuscles absorb the water or watery serum in which they float, and such absorption can assume a degree that they change their form from the normal biconcave disc to a sphere or globule; this alteration cannot but seriously interfere with their function of absorbing oxygen and distributing it through the body. For, as George Henry Lewes points out:[3] "There must assuredly be some relation between the form and size of these discs and their function". And by a further absorption of watery serum the corpuscles burst and are killed.

2. The common salt contained in the blood-serum in the proportion of 0·4 to 0·5 per cent. prevents this abnormal absorption; and its presence in a well-defined

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[1] Zundt, *Fortschritte der Medizin*, Bd. 9, No. 3, pp. 100-101.

[2] Hermann, i.a., p. 104.

[3] G. H. Lewes, i., p. 246.

sufficient quantity is hence a necessary condition for the life and proper function of the blood.

3. By either a total abstinence from common salt, or by an insufficient supply of it, or by a continuous imbibing of liquids and thus washing the salt out of the blood, we reduce the proportion of sodium-chloride to the minimum, whereby the life of the blood, and with it the health and the life of the human body, is endangered. *

I consider that not sufficient stress can be laid upon the importance of these facts, for the reason, that in the question of health, disease and death, they are constantly disregarded, if not absolutely doubted and denied. Proof of this we shall meet with when treating of the diseases, which result from the deficient oxygenation of the blood.

* [illegible] Schuessler [illegible]
with its [illegible] with [illegible]
[illegible] Simple and well [illegible]
[illegible]

CHAPTER XII.

WANT OF SALT IN THE BLOOD.

WHEN dealing with the red corpuscles of the blood, I have purposely omitted to mention the inorganic ingredients contained in them, with the intention of accentuating the character of the mineral constituents contained in the corpuscles, when compared with the salt contained in the serum.

These mineral constituents of the blood corpuscles—besides the iron in the hæmoglobin—are salts of potash, chiefly in combination with phosphoric acid, while the principal salt of the serum is a soda salt in combination with chlorine.

Liebig[1] has pointed out "that these two alkalies" (potash and soda), "although so much alike in many other properties, cannot mutually replace each other with reference to all the purposes which they serve. In the blood of man and of animals fed on grain, the phosphate of potash is always accompanied by common salt; but we know that these two salts cannot exist together without mutually decomposing each other." They cannot be substituted for each other in their physiological action; and these two salts—the phosphate of potash and the chloride of sodium—which outside the blood would interchange their combinations, inside the blood retain not only their original constitution, but also their respective spheres of action.

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[1] Liebig's *Letters*, p. 406.

When a solution of phosphate of potash is mixed with a solution of sodium-chloride, these two salts interchange and form two additional salts, *viz.*, chloride of potassium and phosphate of soda.

$$\left.\begin{array}{l}\text{Phosphate of Potash}\\ \text{Chloride of Sodium}\end{array}\right\} = \left\{\begin{array}{l}\text{Chloride of Potassium.}\\ \text{Phosphate of Soda.}\end{array}\right.$$

Now, although the hæmoglobin and the phosphate of potash are not so firmly combined with the blood corpuscles, but that they can be separated from the stroma; and although the blood-serum, containing sodium-chloride, enters the interstices of the corpuscles, yet these two salts do not interchange their component parts, when meeting within the corpuscles, as they do outside the blood.

There must hence exist some physiological relation between the potassium salt in the corpuscles, and the sodium salt in the serum; and when this latter has reached its minimum proportion, a kind of physiological tension must obtain so long as the blood corpuscles remain in their living condition, which prevents the further loss of common salt from the blood.

If, however, a certain number of corpuscles is destroyed, the hæmoglobin and the potash salt escape from the corpuscles (leaving the stroma), and are diffused in the blood-serum; and under these, what may truly be called morbid conditions, the liberated potash salts, now floating free in the serum, can interchange with the common salt which has been set free by the destruction of the corpuscles.

Certainly it can only be a limited portion of the blood which may suffer, since the sodium chloride, thus set free, would serve to protect the adjacent corpuscles from destruction. But this destruction can proceed gradually—as stated by Mireur[1] in the case of cholera—according as personal or local conditions induce to drinking, *i.e.*, to the further supply of liquid to the blood without a compensating supply of common salt.

This consideration will greatly assist us in the attempt of explaining sudden deaths, since it is not improbable that this *physiological tension* may extend over the whole or greater portion of the blood, may require only the slightest impulse to break through suddenly and spread its destructive action over the whole circulatory system.[2, 3]

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[1] Dr. H. Mireur, *Etude sur la Prophylaxie et le Traitement du Choléra*, Paris, 1884, pp. 25-6.

[2] *Immunity*, pp. 42-3.

[3] This would be a physical phenomenon for which an illustration could easily be found. As is well known, water, when allowed to remain very quiet, can be lowered in temperature below the freezing-point without any ice being formed; but a grain of sand thrown into it will have the effect of causing the surface to be covered almost instantaneously with a film of ice.

CHAPTER XIII.

POTASH SALT IN THE BLOOD.

ALTHOUGH the destruction of the blood corpuscles may proceed by small quantities at a time, still—if the supply of common salt is not attended to, to stop this destruction, the sufferer is doomed, and this may take a more or less comparatively long period. The resulting ailment, whether only a general weakness or anæmia, chlorosis or a more mortal affection, comes on insidiously until the symptoms show a dangerous character.

We must now, however, bring another factor to our notice, which seems to act with greater celerity: this is the effect of a *free* potash salt in the blood.

To understand this in its full bearing we shall have to revert to the constituents of our food, and study Prof. Bunge's[1] excellent exposition of the effect of an animal or a vegetable diet on the constitution of the blood. The importance of the subject induces me to give the demonstration in his own words, as it cannot be better presented than he has done it.

Prof. Bunge says (pp. 106-7): "It is a remarkable fact that, of all the inorganic salts of our body there is only one, which we take from inorganic nature and add to our food, *viz.*, common salt. Of all other salts we are satisfied with the quantities, that are naturally contained in the organic substances of our food. We never need exercise any care about them. With the supply of the organic food stuffs we receive the inorganic salts in the bargain. Only common salt makes an exception. And this exception is the more striking since our food is by no means wanting in salt. All vegetable and animal food stuffs contain considerable quantities of chlorine and of sodium. Why are these quantities not sufficient? Why do we search for and use 'mineral salt'?"

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[1] Bunge, p. 96 *et seq.*, " Die anorganischen Nahrungs-stoffe ".

Prof. Bunge then directs our attention to the difference in the use of salt between the herbivora and the carnivora, and to the fact, that it is chiefly the former who evince this great desire for salt. "This difference is all the more surprising since the quantity of sodium-chloride which the herbivora find in their food is mostly not much less than what the carnivora obtain. There exists, however, a marked difference in another mineral constituent of our food stuffs, *viz.*, *potash.* The herbivora consume at least from two to four times the quantity of potash salts as compared with the carnivora. This fact led me to suspect, that the abundance of the potash salts in vegetable food was the cause of the great desire for, and the consumption of, common salt among the herbivora."

"When, for example, a solution of a potash salt, such as carbonate of potash, intermixes with a solution of sodium-chloride, a partial interchange occurs, resulting in chloride of potassium and carbonate of soda" (as already described at p. 54).

"But *sodium-chloride is, among the inorganic salts, the most essential and necessary constituent of the blood-serum.* Hence, when, through absorption of the food, potash salts enter the blood, a transposition takes place within the latter. Chloride of potassium and a soda salt of the acid" (in the above instance carbonic acid) "which was combined with the potash, will be found."

"In lieu of the chloride of sodium the blood now contains another sodium salt which is heterogeneous—abnormal—to the healthy constitution of the blood, at all events, abnormal in quantity. A strange ingredient or a surplus of a normal ingredient—carbonate of soda—has formed in the blood."

"It is now the function of the kidneys to maintain the normal healthy condition of the blood; hence to eliminate every foreign or the surplus of any normal constituent. As a result, this newly formed sodium salt, as also the chloride of potassium, will be excreted by the kidneys and *the blood will have become so much poorer in chloride of sodium.*"

"The introduction of potash salts has consequently deprived the organism of sodium-chloride. This loss can only be made good by a supply of common salt from without. And thus it is explained why men and animals, nourished by food rich in potash salts, evince so great a desire for sodium-chloride."

Prof. Bunge has verified the correctness of this deduction by experiments upon himself with all the various potash salts, which are met with in the usual alimentary substances. Without any other change in the diet, he introduced during one day potash salts into the stomach. The result was a most remarkable increase in the secretion of chlorine and soda.

"Eighteen grams of potash, in the form of a salt of phosphate or of citrate" (*i.e.*, in combination with phosphoric or citric acid) "taken during the day, in three doses, abstracted from the body 6 grams of common salt, besides 2 grams of sodium of another combination; since this interchange does not only occur between the potash salts and the common salt, but also with other combinations of sodium, such as the carbonate, the phosphate and the albuminate of soda."

"The quantity of potash, which was introduced into the human body in these experiments was by no means so very great; it was considerably less than the quantity of potash contained in the most important vegetable food stuffs. And yet—it withdrew from the body 6 grams of common salt. This is about one-half the amount of common salt contained in the 5 litres of blood of an adult human being."

"Although in the first instance this loss falls upon the blood, there can be no doubt, that the tissues share in it. When, however, the blood has partly made good the loss by drawing on the store of salt in the tissues, a further supply of potash salts in the food to the blood will renew this process, and thus again deprive the organism of more sodium-chloride."

Prof. Bunge, in relation to the above, continues: ". . . that it needed not this extra supply of potash salts to force upon the inquiring observer this serious loss of common salt; already the secretions of soda salts, consequent upon the consumption of the usual vegetable substances, explain to us the necessity of adding common salt to our food, and in face of the important function of sodium-chloride in the organism—to mention only the formation of the digestive secretions and the solution of globulin—*a slight diminution in the quantity of common salt in the system can have already an impairment of certain functions in its train, and produce the necessity of supplying salt to the system*".

As already stated, the quantity of potash (of course as a potash salt) with which the professor experimented, was by no means large, namely, 18 grams. "A human adult, who feeds chiefly on potatoes, supplies his system with 40 grams of potash in the twenty-four hours. This explains, why potatoes appear so insipid if eaten without salt, and why they are never eaten—all the world over—without some strongly salted addition. So also the other important classes of vegetable food, the cerealia and the leguminosa, are rich in potash; this explains the well-attested fact that peasants and country people generally, who live chiefly on vegetable food, eat more common salt than the inhabitants of cities, whose food is more of an animal nature."

Statistics in France have established the fact that the inhabitants in the country eat three times the amount of salt that is consumed by the inhabitants of the larger towns.[1]

We have here then a formidable factor before us, which quietly and insidiously undermines the life of the blood with all the important morbid consequences; without the slightest suspicion, that these indications of an approaching indisposition or ailment (if nothing for the moment more serious) are the result of an apparently innocent and nourishing class of nutriment.

We need not pursue this question further about the relation, which exists between the potash and soda salts in the body; what has been stated above suffices to show the absolute necessity of adding salt to our food, or to supply it in some way to our body to *guard against the destruction of our blood.* But there is one point in relation to the apparent non-necessity of adding salt to our *animal* food, which it is necessary to elucidate in anticipation of any objection, that might be raised against the conclusions we have come to.

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[1] Bunge, p. 110.

Prof. Bunge gives some interesting tables in which he states the percentage of potash and soda salts contained in the various kinds of food, both vegetable and animal, and thus explains, why some people, living almost entirely as carnivora, take or need no salt. He says, and considers it as most important: "In the *bloodless* meat of slaughtered animals we find for *one* part of *soda four* parts of *potash.* It is hence deserving our special attention that *these people, who live on animal food without adding salt to it, take great care in not spilling or losing the blood, when slaughtering the animals.*"[1]

"The Samoyedes" (a tribe in the north-west of Asia) "when eating the meat of the reindeer, dip every morsel first in blood; and the Esquimaux of Greenland carefully stop the wound of the slain seal".[2] No doubt intuitively with the object of retaining with the blood the common salt.

When therefore it is said, that we receive sufficient salt in our animal food, and we are advised not to add any more to it, we must naturally conclude that by inference we are enjoined to take good care, that we receive with the meat as much blood as possible. In other words: *let our meals be as bloody as possible, so that we may have no need to add common salt to our food.*

It must appear surprising, that in our assumed high state of civilisation we should meet with people, who do not hesitate to give an advice, which tends to keep mankind back in their lower animal state of existence, instead of, through a more refined diet, inciting their ethical faculties and thus leading them up to a higher ideal.

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[1] Bunge, p. 115.

[2] *Z. f. Biologie*, vol. x., p. 115.

CHAPTER XIV.

POTASH SALTS AND THE HEART.

WITH the demonstration of the effect of potash salts in the blood as the means of depriving the latter of its sodium-chloride, we have not exhausted this subject; since, irrespective of this morbid effect, we shall find, that the action of a *free* potash salt on the heart is of a serious, nay, a mortal character.

As the result of a series of most interesting experiments, Prof. Bunge gives us the following facts:—

1. That in normal blood the potash salts are almost exclusively contained in the blood corpuscles, and this chiefly as phosphate of potash.

2. That potash salts, when absorbed into the blood-plasma, act as a violent poison.[1]

This no doubt seems very alarming; but our fears of being so easily poisoned will be allayed when we learn, that such large quantities, if introduced into the stomach and sufficient to affect the heart, are vomited and thus expelled from the system before the potash salt or part of it can enter the circulation to do any harm.[2]

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[1] The small quantity of potash salts met with in the blood-plasma is probably the result of effusion of the salt from the corpuscles after the blood has been drawn from the body. (Bunge.)

[2] A distressing case of poisoning by chlorate of potash is reported in the *Berliner klin. Wochenschrift* (copied into *Unser Hausarzt*, 4th September, 1897, p. 273). A poor seamstress obtained 25 grams of

By experiment upon himself, Prof. Bunge has proved, that the dose of potash salt, which can be taken into the stomach short of causing vomiting (about 12 grams), has no influence on the action of the heart; and he thinks we can explain this by assuming, that the interchange between the potash salts and the common salt[1] takes place already in the digestive canal and that thus the various salts are expelled by the rectum, which accounts for the comparatively small quantity secreted by the kidneys. He states: "In cases where death has occurred through the introduction of potash into the stomach, it has been the result of gastro-enteritis" (inflammation of the digestive organs) "and not through paralysis of the heart".[2]

This question bears, however, a different aspect when "the potash salt is injected direct into the blood".

"Through my" (Prof. Bunge's) "own experiments I have convinced myself, that the injection of 0·1 gram of chloride of potassium into the jugular vein of a dog of medium size, instantly causes the heart to stand still."[3]

"The same effect can be produced by means of a subcutaneous injection of a potash salt."

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the potash salt and swallowed it; in spite of all medical efforts to save her she succumbed to the drug, which showed its effect in the destruction of the blood corpuscles. Dr. Paul Jacob, assistant to Prof. Leiden, joins to the above report a warning against the internal use and also *as a gargle of chlorate of potash.* Children especially are in the habit of swallowing some of it when using it in the latter capacity in cases of *sore throat* and *diphtheria.* Chlorate of potash, even in small doses, is a dangerous poison for the blood; and if death does not always follow, it may produce serious affection of the kidneys.

[1] Provided, of course, that this is present in sufficient quantity.

[2] Bunge, p. 136.

[3] *Ibid.*, p. 136.

Let us make this perfectly clear by a repetition : We can introduce into our stomach 12 grams of a potash salt without any detrimental effect on the action of the heart, provided, of course, that a sufficient quantity of common salt is present in the system to promote the elimination of the potash salt through the rectum ; but if we *introduce one-tenth of a gram* (that is the $\frac{1}{120}$th part of the above amount) *direct into the circulation, we almost immediately cause the heart to cease beating.*

Let us now inquire into the relation that exists between this poisonous effect of potash salt and the presence of sodium-chloride in the blood serum of the human body.

We have learnt that the normal shape of the blood corpuscles in healthy blood is that of a biconcave disc ; that the corpuscles absorb the blood serum into their interstices ; that the amount so absorbed depends upon the presence of sodium-chloride in the serum, in the inverse ratio : *i.e.*, the less the proportion of common salt, or what is practically the same, the more watery the blood is, the more will the serum be absorbed by the corpuscles ; that through abstinence from salt, or through insufficient supply, or through copious drinking, we can reduce the absolute quantity and the relative proportion of common salt to a minimum, below which proportion the life of the corpuscles becomes endangered ; that by further addition of water to the blood, the absorption of serum causes the corpuscles to swell and assume the globular (death) form and finally to burst ; that thereby the hæmoglobin and *the potash salts are diffused in the serum ;* and that lastly we have here the phenomenon of a *free potash salt in the blood serum*, which, *upon reaching the heart,* *acts like the injected potash salt and causes the heart to stand still.*

In verification of the possibility of such an occurrence we need but to inquire into the cause of so many sudden deaths of even comparatively young people, all entered in the death certificates (often a very questionable document), for want of a due comprehension of the real cause, as *heart disease.*

CHAPTER XV.

OXYGEN IN THE BLOOD.

AMONG the factors upon which the continuance of the health and the life of the human body depends, the supply of oxygen stands pre-eminent. To deprive the system of the means of inhaling oxygen leads to certain death.

Cut off the supply of oxygen from the brain, or let the supply be only insufficient, unconsciousness and disturbed mental activity are the immediate result. Deficiency of oxygen in the blood, which courses through the capillaries of the muscles, is the cause of physical weakness, spasms and ultimate paralysis; and *insufficiently oxygenated blood cannot excite the nerve-centres of the heart, upon which the pulsations of the latter, and with it the proper circulation of the blood, depend.*

Let us now remember that the special function of absorbing the oxygen from the atmospheric air in the lungs and giving it off again in the various organs is performed by the blood corpuscles.

We also know that the blood corpuscles, through the absorption of a watery blood serum, become distended, swell to a globular form and even burst, are in fact killed; and the presence of common salt in the blood serum counteracts this dangerous tendency.

Here very naturally the question arises, how far this globular distended shape of the corpuscles, produced by the deficiency of sodium-chloride, can and does influence the absorption of oxygen, and thus not only interfere with the supply of this source of vitality, but also be directly productive of disease.

I am not cognisant of any experiments ever having been made to answer that question; but the wonderful perfection of the appliances and means that are available in the modern physiological laboratories should overcome the difficulties which surround such an inquiry.

The experiments, undertaken by many physiologists, have determined the fact, that the absorption of oxygen by the blood is not a mere physical phenomenon.

One hundred volumes of pure water absorb, at the temperature of the human body, about 1 volume of oxygen, and any substance held in solution, whether mineral or organic, diminishes this amount.

The arterial blood of dogs was found to contain about 19 to 20, and that of some herbivora—sheep and rabbits—only 10 to 15 volumes of oxygen in 100 volumes of blood.[1] This absorption of so large a volume of oxygen is explained by Liebig[2] as being due to this gas entering into a loose combination with the hæmoglobin of the blood corpuscles.

The question now before us is: Can the blood corpuscles, when in a swollen globular form, which may be designated (if it not actually is) a diseased condition, properly perform this chemical function of combining with oxygen in the lungs?

I think we are justified in our contention, that this is not the case: that, namely, the blood cannot absorb the gas, and if it does so, it takes place imperfectly and under difficult and unfavourable conditions.

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[1] Bunge, pp. 239-240.

[2] Zuntz, *Die Gase des Blutes*, Hermann, iv.b, p. 48.

The following considerations and facts will support us in our contention. We first need but remember what was said about the ductile nature of the corpuscles, which allowed them to elongate—in fact alter their shape to accommodate themselves in their passage through the fine capillaries—and we can at once understand how difficult if not impossible it must be for the swollen globules to pass through these capillaries, especially when the lung has inhaled atmospheric air of a low temperature, which rather tends to contract the fine blood vessels.

This must naturally produce a check in the circulation of the blood in the lungs, with all the concomitant phenomena of dyspnœa, and as a result, an insufficient oxygenation of the blood.

But there is another cause acting against the absorption of oxygen by the enlarged globules. Manassein,[1] who submitted the blood of 178 different animals to about 40,000 experiments, found that the blood corpuscles become enlarged, through the absorption of oxygen, in the proportion of 1 to 1·10. When now the corpuscles are already distended, and have approached the globular or death form, we can logically assume that such enlargement has a limit, and that thus *a resistance is offered to a further extension*; that is, *to the absorption of oxygen.*

A more positive proof of the inability of distended corpuscles to absorb oxygen is afforded by the following experiments. The red corpuscles give the colour to the blood. When charged with oxygen this colour is a bright red, *provided that the corpuscles are in their normal*

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[1] Rollet, *Physiologie des Blutes*, Hermann, iv.a, p. 22.

biconcave shape. After the blood has passed through the capillaries of the tissues and the various organs, it loses oxygen, absorbs carbonic acid, and is now of a dark colour. Upon the blood reaching the heart and thence the lungs, it is recharged with oxygen, gives off carbonic acid and appears again bright red. The absorbed oxygen is hence a cause of the bright colour of the blood.

But there is another method of effecting this change of colour. It has been ascertained that, when the corpuscles are of the normal biconcave form, the blood appears red; but that, if through an addition of water they swell and become globular, the blood assumes a black colour. When now a proportionate quantity of common salt is added to this black blood, it has the effect of restoring the corpuscles (unless they have been killed, as pointed out above) to their normal biconcave state, and thus of *reviving the healthy red colour of the blood.*

Moreover, as Dr. W. Stevens[1] relates as the result of his experience: "The blood becomes black exactly in proportion to the diminution of its saline matter; and when this is diminished to a certain extent, the vital current becomes so vapid as to be totally incapable of stimulating the heart. When such blood is exposed to the air *it does not become red;* but when we add a small portion of saline matter, even to this black and dead fluid, the scarlet or arterial colour is immediately restored."

"When we cut out a piece of the red crassamentum from healthy blood, which has just coagulated, and immerse this in distilled water, the water rapidly attracts the saline ingredients out of the clot. In proportion as this takes place the colour changes, and in a short period it becomes perfectly black."

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[1] Dr. W. Stevens, *Observations on the Blood*, London, 1832, p. 15 *et seq.*

"When we take this black clot out of the distilled water and expose it directly to the air it remains black, or if we immerse it in a jar of pure oxygen, the oxygen can now no more redden its colour than it can change the colour of the blackest ink. There is but one way by which the red colour can be restored, and that is neither by air, iron nor oxygen, but by restoring to the blood the saline matter which it has lost; and when we sprinkle or rub a small quantity of the muriate of soda (common salt) on the black clot, not merely red, but a colour that is highly arterial, is immediately produced; or when we make an artificial serum by impregnating water with any of the neutral salts,[1] and then take the black clot out of the clear fresh water and immerse it in this equally clear saline fluid, it is immediately changed from black to a bright red colour."

We are hence forced to conclude that the blood corpuscles, when distended through the absorption of a watery blood serum, are deprived of their faculty of absorbing oxygen in a degree corresponding to the deficiency of sodium-chloride in the blood, and we can now well understand how futile are the attempts to oxygenate the blood by inhaling pure oxygen into the lungs, as is so frequently advised to, and is practised by, consumptive patients. The blood will not be in a condition to absorb the vital gas, until it has had its corpuscles restored to their normal shape by the admixture of a proportionate amount of sodium-chloride.

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[1] Any substance, which can draw the water out of the corpuscles, will effect this, but the normal and natural substance for the human blood is sodium-chloride.

CHAPTER XVI.

DEFICIENCY OF OXYGEN IN THE BLOOD.

KNOWING the absolute necessity of oxygen for the maintenance of life and for the proper functions of the various organs of our body, we can estimate the effect of its deficiency and explain the many ailments, diseases and sudden deaths which are the result of it.

The late Sir Benjamin Ward Richardson makes the remark somewhere in his writings or his public speeches, that the (healthy ?) human body contained in none of its organs any indication why the body should die, or words to that effect.[1]

He himself led a life in accordance with strict hygienic rules. He avoided alcohol, even, as is so well known, in the form of wine ; showed a preference for, if he did not follow, a vegetarian diet ; and assiduously took physical exercise, being one of the leaders in the cycling world. Yet—this exemplary hygienarian, this uncompromising apostle of temperance, died suddenly at the comparatively early age of 68 years from "*apoplectic seizure*," that is, "*a sudden deprivation of all sense and voluntary motion*".

The humdrum of the public repeat this : "Oh, he died of apoplexy," and with open mouth admire the ingenuity of the human intellect as exemplified in such a discovery. The astonishing part is, that everybody, the learned doctor as well as the ignorant layman, is satisfied with such a verdict, since scarcely a day passes which does not bring us in the obituary notices one or more announcements of sudden deaths, not to think of the probable number not so mentioned; invariably ascribed to "apoplexy," "syncope," "heart disease" or "heart failure".

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[1] I remember having read it somewhere, but if incorrect I hope that any one better informed will enable me to rectify this statement.

Undoubtedly—we have to bring these cases under the category of heart failure, since evidence goes to show, that it was not the nervous system which "failed". For, it can only be either the heart or the brain (probably more correctly the medulla oblongata) which, in its failure, can cause sudden death.

The activity of the nervous system and the circulation of the oxygenated blood are the factors which immediately influence our vital existence; but as the first, the nervous activity, is dependent on the supply of oxygen, and this again on the circulation of the blood, we can truly declare: *that an unexpected sudden death from inner causes has invariably its origin in the failure of the blood, first, to absorb oxygen, and secondly, through a deficient circulation to supply this vital food to the nervous system.*

Sir Thomas Watson seems to maintain the same view [1] when dealing with angina pectoris under "heart diseases". He says: "Some pathologists are disposed to consider it a merely neuralgic affection. But this doctrine is scarcely consistent in my judgment with the facts, that *the disease is so very frequently and so suddenly fatal. This is not at all the character of mere neuralgic diseases in general.*"

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[1] Sir Thos. Watson, *Lectures on the Principles and Practice of Physic*, vol. ii., p. 283.

No case can better illustrate it—that the cause of such deaths is to be looked for in the state of the blood and the resulting defect in the heart, and not in the nervous system—than the sudden decease of the late Mr. Henry George, the apostle of land nationalisation, and candidate for the New York mayoralty.

"He was apparently in the best of health, cheerful and jolly, and I have never known him to look stronger. In fact he has been gaining strength right along, as the campaign progressed." Full of mental energy, his nervous power never failed, and rather gained by the exertion; but how about the blood and the heart? "During the night he awakened his wife saying, he did not feel well, and seated himself in an arm-chair. He then gradually became incoherent, and lapsed into unconsciousness. A physician was summoned, but all efforts to revive him failed, and he died (fifty-eight years of age), *the cause being apoplexy*."[1] That is: failure of the blood for want of oxygen to stimulate the brain and the nerve-centres of the heart. And we shall find this confirmed if we consult the experiments of physiologists on this point.

Aubert[2] in his treatise on the rhythmical movements of the heart informs us that, "a heart, cut fresh out of the dead body, continues its rhythmical movements for some time; these then become irregular, and at last cease, after which any externally applied stimulus cannot restore the movement.

"Of principal influence on the duration and magnitude of these pulsations are oxygen and carbonic acid. If placed under the receiver of an air-pump, with the air gradually attenuated, the pulsations cease after about an hour, and the heart loses its susceptibility against all mechanical and electric irritants. After readmission of the air the pulsations commence again.

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[1] *Daily News*, 30th Oct., 1897.

[2] Prof. Aubert, Hermann, vol. iv.a, p. 355 *et seq.*

"The same phenomenon ensues, when the heart is deprived of air by any other means. Essential influence on the duration of these movements is exercised by the oxygen of the atmosphere; whereas, carbonic acid diminishes the time.

"DEFICIENCY OF OXYGEN CAUSES APPARENT DEATH OF THE HEART,"[1] and, we are justified to add, *stagnation in the circulation of the blood, and ultimate death of the body.*

Numerous other physiologists have confirmed this[2]—Tiedemann, Schultze, Harless and numerous others; and Donders, after recounting various experiments, states: "All these data prove unmistakably, that the pulsations of the heart depend upon metamorphic changes," *i.e.*, action of the oxygen on the heart.

This of course does not exclude the influence which the nervous system exercises over the heart's action; but this influence does not come into play in the case of sudden death from internal causes.

How perplexing these deaths, whether considered as caused by heart disease, heart failure, syncope or apoplexy, are to the observant physician is well expressed by Dr. Hughlings Jackson[3] when he says: "I would myself say that I do not know how it is, that patients who die of simple apoplexy, or whose deaths are put under that name, become ill, or what the change is in the brain or body. I say change, for although there is no lesion discovered, there must be something wrong. In some cases we may find degeneration of the cerebral vessels ; that is, however, not enough to cause death ; but in others we do not even find this."

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[1] This last sentence appears in the original in large type.

[2] Tiedemann (Müller's *Archiv*, 1847), p. 490. Also Schultze (*De motu cardis ranæ temporarea*, Berol, 1849); cited by Donders in his *Physiologie des Menschen*, Leipzig, 1859, p. 51; etc., etc.

[3] Dr. Hughlings Jackson in Reynolds' *System of Medicine*, vol. ii., pp. 531 and 551.

"Indeed we have seen that some patients die in coma, and we find nothing in their bodies to explain why they became comatose, and why they died in coma."

In whichever way we may look at this question, we cannot well escape the surmise, that these unexpected deaths ascribed to failure of the heart's action—under whatever name they may be classed—are caused by want of oxygen in the blood, and are thus ultimately *due to a deficiency of sodium-chloride in the system.*

CHAPTER XVII.

SUDDEN DEATH.

We have, however, more direct evidence, that these sudden unexpected deaths from inner causes are the result of the destruction of the blood corpuscles, and the consequent failure of supplying oxygen to the heart and to the brain.

In a work entitled *Sudden Death from Internal Causes*, by Drs. Herrick and Popp, the authors give their investigations in ninety-six cases of unexpected decease; in thirty-seven cases without any premonitory signs, the rest with previous slight ailments, without these being either the cause or giving any indication of approaching death. They occurred during thirteen years, and each case was made the subject of a *post-mortem* examination. The authors, in a most elaborate analysis of the symptoms and of the supposed cause of death, come to the following conclusions:—

That neither the conditions of and the symptoms in the central nervous system, nor the respiratory or the digestive organs, nor the liver or the kidneys are such as to account for the sudden and unexpected cessation of life; and whatever abnormal conditions actually existed, these could invariably be considered as the result of a *disturbed circulation of the blood.*

Hence, as a result of their investigation, they found that "the proximate cause of sudden death in most cases was the cessation of the heart's movements, and the consequent paralysis of the medulla oblongata" (*i.e.*, the primary seat of life).[1]

We know now (I am ignorant of the fact, but doubt whether it was known at the time the above-cited sentence was written, in 1848) that a deficient supply of oxygen is the cause of this paralysis of the nervous system; that this insufficient supply is due to inability of the blood to absorb the oxygen, and of the heart and arteries to propel, to circulate the blood; and that these symptoms have their origin in a diseased condition of the blood, this again being the result of an insufficient supply of sodium-chloride to the system.

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[1] Plötzlicher Tod aus innern Ursachen, *Beobachtungen und Untersuchungen von Karl Herrick und Karl Popp*, Regensburg, 1848.

CHAPTER XVIII.

HEART DISEASE.

THIS is a subject which forces itself upon the attention of every thoughtful human being.

With the alarming increase in the number of unexpected sudden deaths, we may well be justified in expressing a surprise, not only at the indifference of the general public, "the laity," but also at the impotence of medical art in coping with this form of disease, when called upon for professional aid to cure, or for prophylactic means to prevent, this destruction of human life.

Death, from inner causes, seems to waylay us at all times and in many forms; to mock the proclaimed science and skill of the "doctors," and to cast a lurid light upon the praises sung at Medical Associations, Medical Societies and in the Medical Press.

Every one must admire the patience and the ingenuity displayed in the researches, which were reported in the several communications made to the British Association during the meeting at Toronto (1897):—

Prof. G. N. Stewart: "On the time that a particle of blood takes to pass through the heart, and on the out-put of the heart".

Prof. T. W. Porter: "Observations on the cause of the beat of the heart".

Prof. Huerthle: "On the effect of the viscosity of the blood on the resistance of the heart's action".

This is Physiology; but what about Medicine?

What about, if not the immediate cure, at least the prevention of the "heart's failure" and of "heart disease"?

Not among the "plebs," the common people, who cannot afford to pay a guinea for a prescription, and hence crowd the out-patient's ward at the hospitals, but at the bedside of more valuable lives.

Is the knowledge of the heart's life and action so deficient, that the cure and the prevention are beyond the capabilities of medical art? It appears so; although at the British Medical Association at Montreal we might have admired the self-satisfaction with which Dr. William Osler, Professor of Medicine in the Johns Hopkins University, Baltimore, sings the praises of the profession in the following words: "Free" (he does not say in which qualities?), "cosmopolitan, no longer hampered by the dogma of schools, we may find a just pride in a profession *almost totally emancipated from the bondage of error and prejudice*".[1]

Who is to judge? The layman is laughed to scorn for presuming to do so, and the honest physician, who dares to protest against such unfounded "Mutual Admiration" rhetoric, finds his voice drowned by the clamour of the professional masses (and the penny-a-liner of the daily press). But the ignorant lay people suffer and die.

Medical men complain about the scanty remuneration for their services; yet they cannot take advantage of advising a millionaire, how to escape a sudden death from heart disease; *to wit*, Mr. George M. Pullman.

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[1] *The Times*, 2nd Sept., 1897.

The profession declaims about the want of adequate acknowledgment of its important standing in our social fabric,[1] yet cannot prevent H.R.H. the Duchess of Teck from succumbing to a weak heart, which was acknowledged by the medical attendants as the immediate cause of death.

Dr. Chas. Roy—himself a medical man—distinguished as a brilliant physiologist, who was the first to gain the George Henry Lewes's Studentship for Physiological Investigations, dies at the early age of about forty years.

Prof. Humphrey dies at thirty years of age; a man of education and high scientific standing, and not an alderman, who feasted himself to death. (See list of sudden deaths in Appendix.)

But it is not necessary to enumerate these cases, they occur daily; we are surrounded by them; to hear the usual, repeated announcement — cause of death : apoplexy, syncope, heart failure.

Any inquiry into the phenomena, accompanying and resulting from an abnormal condition of the heart and of the arterial circulation, which may result from a deficiency of common salt in the blood, must, as a matter of course, exclude congenital malformations or anatomical injuries which are met with in this important part of our organism.

It is, however, incontrovertible, that a heart, originally healthy and strong, can become weakened and diseased through even a slight deviation of the blood from its normal composition, and through an inconsiderate neglect of proper physical exercise, if this is extended over a prolonged period.

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[1] *The Lancet*, 8th January, 1898, complains, that out of the few recipients of New Year's titles and decorations *only six* have fallen to medical men.

Let us take the case of an otherwise healthy human being in whom, through aversion or neglect, the common salt has been reduced to the minimum proportion of 0·25 per cent. This, as we have seen above, tends to an enlargement of the blood corpuscles and a deficient supply of oxygen to the organs, including of course the heart. But the watery serum, penetrating into the muscular tissues, will cause these to swell ; and this bloated, soaked condition of the muscles (of the heart as well as of the body generally) will tend to enfeeble them for physical exertion, augmented by the just-named deficient supply of oxygen.

The slightest muscular exercise will hence cause fatigue, and this will induce to indolent habits and a sedentary life. And although the heart never ceases to beat while alive, it is quite natural, that under these conditions its muscles should also suffer from this watery state of the serum, and become further enfeebled through want of judicious physical exercise. For we must not lose sight of the fact, that by moderate movements of the various muscles of the body the circulation of the blood, and consequently the work of the heart, is essentially assisted.

The result of this deficiency of salt in the blood and the want of bodily exercise is the degeneration of the heart and of all muscular fibres, leading ultimately to various constitutional ailments of a more or less serious nature.

Again, for want of sufficient salt in the blood, the albumen will have a tendency to viscosity ; it will, in a sluggish circulation, adhere to the walls and the valves of the heart, cause a marked impediment to the already impaired circulation, and lay the foundation for serious disturbances in the various functions of the organism.

We have, in a previous part of our inquiry, explained how a portion, perhaps only a small portion, of the blood can have its corpuscles destroyed, and the hæmoglobin and the potash salts diffused in the serum. This portion of the blood circulates with the rest, and keeps more or less together until it is gradually distributed and mixed with the other part of the blood or until the potash salts are excreted by the kidneys. But so long as it circulates it may reach the heart, and through its unhealthy state, its want of oxygen, may so influence the nerve-centres of this organ as to cause the so frequently observed "palpitation of the heart".[1] Of the entire cessation of the heart's beating, through the presence of "free potash salts," we have already spoken above.

It is, however, not the affections of the heart alone which come into question here. "Apoplexy and palsy, in a scarcely credible number of cases, are directly dependent on hypertrophic enlargement of the heart. No less frequent are the most dangerous cases of asthma, of dropsy, and of epilepsy, referable to diseases of the heart; and this malady seldom occasions long-continued obstruction of the circulation without producing enlargement of the liver."[2]

Thus we learn the train of morbid consequences following the deficiency of common salt in the blood.

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[1] In a recent Continental publication the following advice is offered to combat the feeble action of the heart in children during an attack of a zymotic disease, by Dr. Sevestre of Paris, *viz.*: "A subcutaneous injection of caffein, benzoate of sodium and distilled water; and the same with an addition of vaseline, siryp. tolut., coqnak, etc., for internal use". [*Medizinische Novitäten*, Feb., 1895, p. 19.]

This sounds highly scientific, but certainly it reads more like a prescription from a medicine-man among savages, whose mind is still domineered by the idea of magic in drugs. It is worthy of a layman who is "playing with opinions".

[2] *Cyclopædia of Practical Medicine*, vol. ii., p. 387.

Let us now inquire into the modern views of heart disease and the most approved means suggested for its treatment, as propounded in present-day medical literature and medical practice.

"The subject of cardiac pathology has become much more prominent and important of late years," says Dr. Joseph Kidd,[1] "because of the increase of heart disease due to the following causes:—

"1. The strain suddenly put upon the heart by the hurrying to catch trains, rushing up stairs and along platforms, with the death-like struggle to get in before the train starts.

"2. The strain upon the muscular structure of the heart and large vessels by violent exercise, especially rowing and running."

Physically, I think, there can be no difference between these two kinds of exertion; both, if equally violent, equally affect the muscular structure of the heart; the difference exists in the duration of the exertion, and not in the manner in which such exertion affects the heart.

Such an explanation appeals to the common superficial understanding, but cannot be accepted as a physiological exposition of the distinct causes of heart disease.

If a healthy heart can become diseased—weakened—by mere physical exercise, in that case we must wonder who, of all the football players, runners and rowers, can escape. Guided by the teachings of physiology we would conclude that, with healthy blood, physical exercise of all kinds, whether running after a train or after a ball, whether hunting or cycling, cannot cause heart disease; but *an unphysiological diet and sedentary habits will*

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[1] Dr. Joseph Kidd, *Heart Disease and the Nauheim Treatment*, 2nd ed., London, 1897, pp. 27-29.

produce it. If, after violent exercise, the heart suffers, it is owing to the blood's inability to absorb oxygen and to the consequent feebleness of the heart and the arteries to propel the blood through the vascular system; and if actual injury is the result, then this is owing to a prolonged unhygienic treatment of the body, which has gradually made the heart unfit for any extra strain on its functions.

Dr. Kidd next enumerates typhoid fever, influenza, rheumatic fever, gout, Bright's disease, alcoholism and excess of animal food, as the various causes which, either directly or indirectly, produce heart disease. We can easily comprehend that such maladies as typhoid fever, influenza and rheumatism, etc., which affect the whole organism, will not leave the heart uninfluenced; but when we are referred to personal habits, alcoholism and excess of flesh food, reprehensible as these are, we would venture to express the opinion, that the inordinate consumption of artificial and natural potash, lithia and other mineral waters, which contain little or no sodium-chloride, has, next to the otherwise inefficient supply of common salt to the system, to account for the increased number of enfeebled hearts, and it is not at all appropriate here to ask:—

"What has been achieved by scientific medicine in the prevention and the cure of heart disease?"

In a charming little book Dr. H. Wehberg[1] remarks: "The heart's weakness and 'digitalis' belong together with most practitioners, as do fever and fever-suppressing medicines".

Digitalis (English, foxglove) is a poisonous plant, and is considered as one of the few firmly established "specifics" (according to Dr. Goodhart,[1] medical science can boast of fifteen altogether), which are the pride of the profession. There is absolutely no chemical or physiological connection between the heart with its function and the plant foxglove; the administration of the latter is entirely "empiric" and certainly not physiologico-medicinally scientific except in medical treatises. It is prescribed (medically indicated) for too frequent, feeble and irregular (unrhythmical) action of the heart, since, through its irritating effect on a certain nerve, the vagus, connected with the heart, it lessens the pulsations and apparently soothes and quiets that organ.

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[1] Dr. H. Wehberg, *Der Kampf um die Lebens-anschauung und der Arzenei-Aberglaube der Aerzte*, Berlin, 1891, pp. 17-18.

But, as Dr. Wehberg points out,[2] "with the appearance of muscular exhaustion the action of the heart adapts itself to the existing conditions of nutrition and to the resistance offered to its contraction; the heart endeavours to perform its functions with economic regard to its muscular capability, and does this by more frequent but less powerful pulsations. According to E. Weber's researches on muscular contraction, it is established, that a fatigued muscle will raise a small weight comparatively easy, but fails to lift a larger one."

"Since the enfeebled muscles of the heart are better able to do the work, demanded of them by the organism, when they contract more frequently against a lessened resistance, we cannot but admit, that this is a very natural and appropriate adaptation to the conditions involved. To irritate the 'vagus' is hence but a superficial and dangerous dynamic jugglery; for, setting aside the mechanical effect, the body and its organs are still further damaged by being paralysed."

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[1] Dr. Goodhart in *The Lancet*, 30th Oct., 1897.

[2] Wehberg, p. 19.

In other words: *to lower the frequency of the pulsations by paralysing the nerves of the heart, is not attacking the cause of the ailment.*

I may be blamed for dwelling too long, or perhaps at all, on the drug treatment of heart disease; but I think that, besides forestalling the scientific criticism of "legitimate medicine," the whole subject deserves all possible attention and inquiry in face of the truly alarming number of sudden deaths from heart failure.

But the profession tacitly admits the doubtful, if not deleterious action of digitalis by the great attention, which has lately been paid to a new method of treating heart disease, namely, the so-called "Nauheim Treatment," which has been received by medical men with a certain amount of enthusiasm. Several books have been written, a number of papers have been read before medical societies, and dissertations innumerable have been published on this new therapeutic system, from which an ignorant (but logical) layman must naturally conclude, that all previous methods and means for combating this class of ailments, have been a failure.

This new treatment takes its name from a well-known watering-place in Germany, the "Bad Nauheim," and consists of salt-water baths, combined with physical exercise—of course, prescribed and superintended by medical men.

So then after all, *common salt* is called into requisition to effect, what the whole pharmacopœia has failed to accomplish.

The waters of Nauheim (the Cur- and Carl's Brunnen) contain "chloride of sodium and chloride of calcium,[1] with a small amount of iron and a very large quantity of carbonic acid. The chloride of calcium is about a tenth of the amount of the chloride of sodium. The amount of carbonic acid gas is nearly identical with the iron spring at Schwalbach, where the natural carbonic acid gas covers the bather with layers of bubbles. The theory of Dr. Schott as to the action of the Nauheim baths is: that they stimulate the cutaneous nerves, and thus, by reflex action upon the heart, slowing and strengthening the muscular power of the ventricles."[2]

But Dr. Schott fails to show how this irritation of the skin—either by the chloride of sodium or by the chloride of calcium or by the carbonic acid or by the temperature—can specifically influence the ventricles of the heart, and this in such a manner as to effect a cure of the ailment. The baths may equally, by reflex action, influence the brain, the lungs, the liver, the kidneys, etc., and there are no grounds for assuming, that such special influence will benefit the heart beyond the duration of the bath.

Dr. Kidd gives us, what appears to be a more reasonable theory of the action of the bath: "The most simple and natural explanation is that the action is physical, withdrawing the blood from the heart and large vessels into the capillaries thus lessening the distension of the ventricles. As the tension is relieved, the cardiac muscle is enabled to contract more vigorously" (?), "the dilatation of the heart is lessened, diaphoresis" (perspiration) "and diuresis" (micturition) "follow, with relief to the circulation."

First let us consider that these baths are taken at a temperature of 96 down to 85° F.; they are warm baths and as such promote the circulation of the blood in the capillaries of the skin ; these by expanding through the high temperature alone—without the assistance of either of the salts or the iron or the gas—draw the blood away from the heart, thus facilitating the contraction of the latter—this, however, to a very small extent *owing to the intervening arteries.* When, however, once this withdrawal of blood from the interior vessels to the skin has taken place, the heart will have the same work to do as before, especially so, when the patient leaves the bath and his skin has resumed the previous temperature and the blood-vessels of the skin have recontracted to their normal size.

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[1] See p. 174.

[2] Dr. Kidd, pp. 13-16, 18-19.

Considering that one bath lasts only from five or seven up to twenty minutes, it is difficult to explain, either physically or physiologically, how, as a bath, such a procedure can remove the cause of the heart's weakness. And even the repetition—a series of twenty baths in twenty-eight days, as the shortest course, one bath lasting say ten minutes and acting only by relieving the heart of a very small part of its work during the first two or three minutes—how this is to endure in its effect for twenty-four hours and thus to attack the cause of the evil is very questionable.

Besides, this is only the physical effect of *the temperature* which can be produced by any ordinary warm bath, and leaves out of the question the presence of the chloride of sodium, the chloride of calcium and the carbonic acid.

We cannot be surprised at Dr. Kidd remarking : "The long course in many cases destroys the good effect of the short course. The doctor, hoping" (is it for want of a comprehension of the true nature of his proceedings ?) "to do more good by prolonging the treatment, finds that exhaustion follows and the ultimate result is often bad and discouraging."

And case No. 1 illustrates this: "He" (the sufferer) "had a six weeks' course. At first he improved, but after the tenth bath felt himself to be getting weaker. He returned with the dilatation of the heart just the same as when he went, the mitral murmur louder and more pronounced. For many months after his return he was low and out of condition, an easy prey to influenza."

Not only the result of the treatment but also the diagnosis seems doubtful. "Sir Thomas Grainger Stewart and Dr. Holman reported that, after a duration of eight minutes in the bath, they percussed the patient's heart, and found that the dulness had receded in every direction."[1] Dr. Kidd remarks upon this: "Careful percussion of the heart's area, before and after the bath, generally shows a diminution in the amount of cardiac dulness; but this is an unreliable fact, not absolutely trustworthy". And on the whole treatment he very justly thinks that (p 6) "much of the benefit derived at Bad Nauheim is no doubt due to the total change of scene, the open-air life, freedom from business cares and anxieties".

There is no need of mentioning the system of exercise combined with the baths; it lies outside our subject; but the result of these movements is illustrated in case 2, which ended with the bursting of "a small blood-vessel on the lungs; slight hæmoptysis came on, which continued for upwards of three months, so that most of the gain from the course was lost. The breathing was not improved." Yet Dr. Bezley Thorne declares[1] about the treatment generally: "There is no magic in it—all is clear". *Comment is not needed.*

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[1] *Medical Annual* for 1897, p. 285.

Guided by the result of our inquiry as to the nature and causes of the heart's ailments, we would judge the Nauheim baths, I think, as follows:—

The bath, through its temperature in enlarging the blood-vessels of the skin, facilitates the flow of the blood; this, however, only momentarily and to a very slight extent; the effect soon ceases and is completely destroyed, immediately after the bath. By the osmosmic action of the brine bath (see p. 13), the absorption of water by the skin is prevented; the system is rather relieved of moisture, and this reduction of water—equivalent to an increase in the density of the common salt in the blood—would have a beneficial effect on the blood corpuscles for the absorption of oxygen and the consequent supply of this latter to the nerve-centres of the heart.

The action of the chloride of calcium is, in the bath, apocryphal; and for drinking water, in cases of adults, very questionable; while that of the carbonic acid is a mere irritation of the skin, an excitation of the cutaneous nerves, without any direct physiological connection with the ventricles of the heart, certainly not more than with any other organ. The whole effect so far is ephemeral and never touches the seat or the cause of the disease.

Whatever good result *can* be obtained is achieved through the absorption of common salt from the bath through the skin; and the salt which thus enters the circulation facilitates the absorption of oxygen, im-proves the breathing and gives renewed stimulus to the whole nervous system. This increased proportion of sodium-chloride in the blood *abstracts water from the muscles of the heart*, and thus renders this latter more capable of sustaining any increased exertion, that it may be subjected to.

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[1] Dr. Kidd, p. 6.

Besides this, *the common salt tends to loosen and dissolve albuminoid deposits on the walls and the valves of the heart;* and it thus in every way acts directly and lastingly in removing the cause of the malady, provided of course that the patient *does not counteract the good effect by an injudicious imbibing of abnormal quantities of plain water.*

Whether under the circumstances a brine bath is the best method of supplying salt to the system for restoring the strength of the heart, I shall make the subject for further remarks later on.

Dr. Kidd mentions Prof. Dr. F. W. Beneke as the originator of the Nauheim treatment, or as the first to point out the beneficial effect of the baths in cases of heart disease.

Certainly he could not refer us to a more honest, a more thoughtful and higher authority than the author of the *Balneologische Briefe*,[1] and we shall be anxious to hear what Dr. Beneke says about the Nauheim treatment in his latest work.

The whole subject of the treatment of heart disease at Nauheim is condensed into about fifteen to twenty lines in a book of 220 pages. He says: "The greatest harm is produced by an unreasonable generalisation of single correct data, which so often happens. I have the best proof of this in my own experiences, which I have published, on the beneficial influence of the Nauheim baths in cases of *affection of the heart connected with articular rheumatism.* Scarcely have these experiences become known and been acknowledged by many of my colleagues, when already all kinds of heart failures, which have no connection with rheumatism, are sent to Nauheim. Heart-affections connected with granulated kidneys, endo- or pericarditis as the sequelæ of scarlet or puerperal fevers, atheromatous diseases of the valves, and other possible heart maladies are sent to a watering-place, which is recommended only for a definite class of ailments, and when these baths fail to have the desired effect, then it is said that the published experiences are false and are written *pro domo.* This happens in many instances, and opens the door to confusion and to disputations amongst therapeutists."

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[1] Dr. F. W. Beneke. The high tone, which characterises all Dr. Beneke's writings, stamps him as an honest and earnest teacher of, and searcher after, truth; and his *Physiologische Vorträge*—brought up to date—deserves a foremost place among books for scientific education.

Dr. Beneke adds : "The first thing we need is a clear and calm pathological reasoning".[1]

So much then for the Nauheim treatment of heart disease, which we shall soon see deposited in the limbo of past medical failures, to be replaced, let us hope, by the simple daily administration of common salt solutions as described and advised below, probably in combination with brine baths or other simple physiological means.

The natural outcome of our inquiry into the causes of apoplectic seizure, syncope and heart failure, would lead us to suggest that in cases, when a solution of sodium-chloride cannot be administered *per os*, to do so by a hypodermic injection of a 1 per cent. salt solution; this would be preferable to an intravenous injection, since in the former the sodium-chloride would be better distributed over the whole mass of the blood by its *gradual absorption.*

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[1] *Balneologische Briefe*, p. 123.

But *prevention is after all best*, by forestalling such attacks through a daily judicious supply of common salt in solution to the system.

CHAPTER XIX.

SALT AND THE LIVER.

WHEN a few years ago Mr. W. H. Mallock raised the question: "Is life worth living?" *Punch* answered very pithily, "That depends on the liver"; and never was a truer word said in jest. For in the chain of processes inside the human body, which form the basis for the existence and the maintenance of the animal economy, there is none which can surpass the action of the liver in its influence on the healthy condition of the human body generally, or in its interaction with the functions of the other parts of the organism.

Who has not suffered, at least once in his life, from a so-called bilious attack, as the result of imprudence in the enjoyment of a public dinner, a domestic celebration or other convivial meeting? With dolorous, pitiable features we find ourselves unfit for any mental occupation; with sickness of stomach and the digestive process completely disturbed, we show great aversion to any kind of physical exertion, and life appears truly a burden to us. Whatever the cause—whether a mere fit of indigestion, or a surfeit of "rich," *i.e.*, fat food, or an inactive liver, produced through want of physical exercise—we have in common salt an effective prophylactic means against these attacks, fully confirmed by years of practical experience.

To place, however, the relation of sodium-chloride to the functions of the liver, and the full bearing of the latter for the animal organism, in a proper light, as the whole subject deserves, I think it best that we should inquire into the nature and action of this, the most important gland in the economy of the higher vertebrate animals.

The liver is the largest gland in the human body, and its functions are various. We have already referred to it, that it submits the chyle, immediately upon its entry into the circulation, to a process of selection ; it separates abnormal mineral substances (even drugs) ; stores necessary ingredients, such as sugar, iron, etc., for ultimate use ; it is the principal organ for the formation of urea ;[1] and lastly and most important of all, it forms and secretes the bile from the blood. This process of secretion goes on continuously at varying degrees ; during digestion, the bile is conducted into the duodenum, but when not so needed it is poured into the gall-bladder.

The bile is a most composite liquid. Of its mineral ingredients sodium-chloride takes the first place, although the phosphates exist in considerable quantity.[2] And this presence of common salt is not accidental, as has been pointed out by Liebig, who directs our attention to the fact that "the bile of land animals contains a predominating quantity of oxide of sodium, although their food contains chiefly potash salts".[3]

Bunge gives the amount of sodium-chloride in the bile of two corpses (eighteen and twenty-two years old respectively) as 2·5 and 2·0 per 1000 ; and in a case, where the bile was taken through a fistula from the hepatic duct of *a strong healthy man as* 5·5 *per* 1000.

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[1] Bunge, pp. 298-301.

[2] Donders' *Physiologie*, p. 250.

[3] Liebig's *Letters*, p. 406.

This may account for it, that common salt is, among the normal ingredients of the system, a very effective means for promoting the secretion of bile and for the prevention of "bilious attacks". It is surpassed in this only by sulphate of soda; but as this, also known as Glauber salt, is abnormal to the healthy human body, it does not concern us here.

The bile, after being poured into the duodenum, mixes with the food immediately after this latter leaves the stomach; but the greater portion of *the bile is now reabsorbed into the circulation;* the remainder passes along the intestines with the food, to assist in the absorption of fat, to prevent fermentation in the contents of the intestines and to be ultimately expelled with the fæces.

Now let us ascertain the result when the bile is abstracted from the body, before it can enter the duodenum. Most interesting experiments have been undertaken to answer the question: Is the bile secreted as a substance which, in the normal state of the body, should be expelled? or does it serve further purposes in the economy after being reabsorbed by the intestines and so restored to the blood?

It is not the place here to enter into a full description of these experiments. My object is to point out *the importance of the bile in the human body, and the great necessity for a sufficient supply of common salt, as the normal agent to promote the formation and secretion of bile by the liver.*

That the bile is more than merely an agent for assisting in the digestion and absorption of food, is indicated by the fact, that its formation and secretion commences in the third month of the life of the fœtus; whereas the activity of all the other organs, the secretions of which assist in the digestive function, begins only after birth, with the first ingestion of food into the stomach.[1]

This fact alone should induce us to look upon bile as a factor, absolutely necessary for the life, the growth and the maintenance of the human body. Let us make the attempt of forming a more definite idea of this, in which the following reasoning will assist us: There is no rest in nature anywhere. "All things change" (or flow or move), as Heraclitus says. Nervous matter also changes; it is used up in the life of the body and requires replenishing. It must have food, and this food must be of a specific kind; it must be specially prepared to be fit for the formation of new nervous matter. Furthermore, it must exist in the blood, either ready prepared, or in such a condition as to become assimilable by the nerve-ganglia.

In searching for a seat of the place or an organ, where this preparation of nerve food is or can be specially prepared, we must naturally be guided by an inquiry into the chemical composition of nervous matter, and then compare with this the chemico-physiological products of any organ, in which similar or analogous substances are found. The result of our inquiry would naturally point to the liver as the gland in which this nerve food can be prepared, owing to the great similarity, in one or two points almost identity, which exists between some of the ingredients in the bile and those which are found in the composition of nerve and brain matter. At all events there is no other secreting gland or other constituent in the blood, which can have a greater claim to such a distinction.

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[1] Bunge, p. 194.

There are many data in the physiology of the human body, which could be brought forward to support this view ; but I will only mention one which is a statement of Baron Liebig. He says :[1] "No part of any organised structure contains soda ; only in the serum of the blood, in the fat of the brain and in the bile do we meet with that alkali".

To determine the character and the ultimate office of the bile in the animal economy, the latter—the bile—instead of allowing it to be reabsorbed, has been extracted by suitable contrivances ; and the results of the experiments made by Bidder and Schmidt [2] are given in a condensed form by Prof. Maly :[3] "The digestion appeared to be as usual ; the intestinal evacuation was however feeble and less frequent. The fæces very soon" (after the application of the fistula for abstracting the bile) "assumed a greasy clay-like condition, were of a grey or greenish colour and diffused a truly mephitic odour about them ; decidedly indicating a highly putrescent state. This latter was further proved by a strong development of gas in the intestines, the continuous rumbling noise in the abdomen and by the escape of a very pestilential flatus. Even the breath became highly offensive. Despite the emaciation the animals continued cheerful ; they were however very weak. The beat of the heart remained normal; *the powers of life ebbed away without any disturbing symptoms; it was a general marasmus, which ended after a short time in death.* In not one of the various organs could there be discovered any lesions" (any damage or deviation from the normal state); "it was impossible to find anywhere an adequate cause of death."

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[1] Liebig's *Animal Chemistry in its Application to Agriculture and Physiology*, London, 1843, p. 63.

[2] Bidder und Schmidt, *Die Verdauungssäfte und der Stoffwechsel*, Leipzig, 1852, p. 103 *et seq.*

[3] Prof. Maly, Hermann, v.b, p. 184.

Let me add: And so dies the nervous system, while all its subservient organs are still able to prepare its food of which it has been deprived by a withdrawal of the bile.

We will now endeavour to discover, what influence common salt can have on the secretion of bile, as also on its reabsorption in the intestines. The characteristic feature in these special constituents of the bile is their chemical combination with sodium. We have already, in a previous part of our investigation, been informed, that most organic substances—especially fat—do not to any degree, if at all, pass through animal membranes; yet the greater number of processes in our body—for the growth, the nourishment and the healthy condition of the latter—depend upon the passage of so-called colloid substances penetrating through the various membranes of the organism. To enable these processes to be effected the organic constituents are combined with crystallisable salts, for which common salt furnishes the principal ingredient.

So in the liver. Those specific organic compounds which are only found in the bile[1] are chemically combined with soda, and this latter can only have reached the system in the form of sodium-chloride.[2] Owing to this presence of soda in these organic compounds of the bile, these latter become soluble and crystallisable and acquire the power of penetrating through animal membranes. And this capability appears to be imparted to the fat (of the food in the intestines) with which these special organic (crystallisable) compounds of the bile unite.

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[1] Bunge, p. 189.

[2] Liebig, p. 406.

Let me repeat here what Prof. Bunge[1] says about the danger connected with a deficient supply of common salt; that namely: Considering the important part performed by sodium-chloride in the animal economy, we are justified in assuming, that already a slight diminution of it can become the cause of serious disturbances in certain functions. *And one of these functions so influenced by a deficiency of common salt in the system, is unquestionably the formation and the secretion of bile by the liver.*

Here I must invite those who suffer periodically from biliousness to make the simple attempt of supplying common salt to their system—as advised and described further on—for the purpose of experiencing the signal effect produced, *viz.*, cessation of all the serious symptoms. It only requires patience and perseverance extending over three or four weeks; but the reward is sure to come.

When common salt, administered daily in solution, has had such almost astonishing results, as I shall be able to report under "Practical Experiences," we may, I think, ascribe it as much to its agency in promoting the function of the liver, as on the beneficial influence it exercises on the system generally.

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[1] Bunge, p. 109.

The full extent, to which the liver is affected and in which it interferes either in the pathological development of the various forms of disease or in the effect of drugs on the whole organism, but especially on the nervous system, is a subject that demands fuller inquiries; and the greater the knowledge obtained about the life and function of the liver, the more shall we understand and value the power and the assistance of common salt in the prevention of disease.

CHAPTER XX.

SALT AND DIGESTION.

An eminent German writer has composed a jocose treatise, in which he endeavours to show, that the stomach is the centre of the universe. We can readily accept this proposition in its metaphorical sense, since our daily experience must convince us, that a good or bad digestion is closely interwoven with all the weal and woe, the ups and downs, the joys and miseries of our individual existence. Not only our temporary happiness, but also our future health and the longer or shorter duration of our life, are all directly influenced by the way, in which the stomach performs its function; and if common salt can in any way contribute to stimulate the latter in a beneficial degree, it will add another reason for the high value, which we have already learnt to assign to this mineral food.

Let us therefore inquire, what physiology can teach us as to the part which, directly or indirectly, sodium-chloride performs in the various functions of the digestive and assimilative process, and what consequences accompany an insufficient supply of this mineral to our system.

The result will show us that the *immediate* influence is not so great as the *mediate* one. It has already been mentioned, that common salt assists favourably in stimulating the glands for the secretion of the various juices required for the digestive process; in the mouth to promote the secretion of saliva; in the stomach that of gastric juice; in the intestines that of other intestinal fluids; whilst it is said to assist in the absorption by the intestinal walls of sundry parts of the dissolved and chymified food. This would seem to be supported by the sometimes truly wonderful effect observed in the improved condition of the general system upon the administration of salt, even in small quantities, after having been previously withheld and when not counteracted by bad habits.

There is, however, another, and to my mind a most vital function, which common salt has to fulfil in the fundamental process on which the nourishment and the maintenance of our organism depends and which imparts to the latter the power of resisting disease—a power that deserves to be designated as the cause of the true natural immunity against infectious diseases.

An exposition of this function will now claim our well-deserved attention.

I have often been surprised at the apparent astonishment with which listeners have received my remark, that our food must not only be dissolved, but it has to undergo a chemical change for the purpose of nourishing our body, and that on the proper performance of this change depend the state and the maintenance of our health, and the prolongation of our life. This chemical change is induced by the various secretions which mix with the food, commencing already in the mouth by the action of the saliva, of which every one can convince himself when *masticating* and *insalivating* a piece of dry bread or biscuit; turning it over twenty times in the mouth before swallowing it, as a French physician so well advises; the sweet taste will indicate, that it, the amylaceous food, has changed into sugar.

Were all food so masticated and insalivated, of course unaccompanied by drinking during the meal, how few disordered stomachs we should encounter, and how much disease would be prevented. And here comes in the use of salt in our food, not to produce a "salty taste," but to stimulate the salivary glands. With the habit of eating dry food, these glands develop a wonderful power of secreting saliva. Moleschott[1] declares: it is more than probable that an adult of about thirty years of age, and weighing 63 kilogr. (about 10 stone), secretes about 1400 grams of saliva in twenty-four hours, equal to 3 lb. in weight; a little over one quart.

But even if the saliva does not act as a ferment, and only serves the purpose of a solvent, which may be effected by water or any other beverage, there is still another function which it performs, and in which any other liquid cannot very well replace it. Owing to its viscous, its glutinous nature, it separates the particles of well-masticated and *well-insalivated* food; and thus, when this latter reaches the stomach, it is in a better condition to allow the gastric juice to penetrate into the comminuted mass.

That under these conditions the stomach digestion can take place with greater ease, and with less accompanying disturbing symptoms, is readily understood; but the important bearing and the full meaning of this accessibility of all the ingested particles for the gastric juice we shall learn immediately. In the meantime, I wish to call attention to it, that people, who do not take salt with their food, not enough to stimulate the action of the salivary glands, are mostly in the habit of sipping liquid between mouthfuls; and thus, more or less, destroy, or diminish, the secretory powers of those glands. It is the commencement of a train of apparently insignificant bad habits, which have, however, in the end very significant morbid results.

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[1] Moleschott, *Physiologie der Nahrungsmittel*, Giessen, 1859, p. 46, and Table LXVII.

Certainly, the addition of salt to our food will assist in reawakening the salivary glands to their normal activity and promote the secretion of saliva under healthy conditions.

Well may Dr. Kitchiner[1] exclaim: "Salt is *Aliorum condimentorum condimentum* and the most salubrious and easily obtainable relish which Nature has given us to give sapidity to other substances; and has this advantage over all other sauces, that if taken in excess, it carries its remedy with it in its aperient quality".

Prof. Bunge directs attention to another office which is performed by a free flow of saliva. He states: "The constant secretion of saliva tends to keep the mouth and especially the teeth clean and pure. Remnants of food remaining behind in the mouth would, through their decomposition, form acids, which would be very detrimental to the teeth; this is prevented by the alkaline saliva."

"Chloride of sodium," says Dr. Beneke,[2] "is one of the most important excitants for the secretion of gastric juice; and the Russians, well aware of this, are in the habit of beginning their meals by partaking of a slice of bread with common salt." This is certainly preferable to a "*cock-tail*" or an "*eye-opener*".

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[1] Dr. W. Kitchiner, *Art of Invigorating and Prolonging Life*, London, 1824, p. 230.

[2] Prof. Dr. F. W. Beneke, *Grundlinien der Pathologie des Stoffwechsels*, Berlin, 1874, p. 324.

The stimulating effect of common salt on the secretions extends, as already stated, to the stomach and the intestines; we need not further dilate upon this part of our subject. But we will now inquire into the secretion, action and constitution of the gastric juice as the most important object before us.

Moleschott, referring to the same experimenters as cited about the saliva, gives the amount of gastric juice, which is poured into the stomach during twenty-four hours as 16·8 kilogr. (equal to more than 34 lb., or about 3½ gallons; surely enough to satisfy the highest demand for a diluent of our food). Its active principle, which incites to a chemical change in the albuminoid constituents of our food, is an organic substance called pepsin. In 1000 parts of gastric juice are contained :—[1]

Organic matter (pepsin, etc.)	3·19
Sodium-chloride	1·48
Other salts	0·73
Hydrochloric acid	0·20
Water	994·40

In relation to these quantities I must ask you to remember the proportion in which common salt exists, *viz.*, 1·48 per 1000, as I shall have to refer to this again later on. What will absorb our attention here is the nature and amount of acid contained in the stomach secretion, as it performs one of the most essential offices not only in the digestive process but for the protection of the whole human organism.

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[1] Moleschott, *Physiologie der Nahrungsmittel*, Table II., p. 3.

As the result of the earliest inquiries into the constitution of the digestive ferments it was discovered, that the pepsin was accompanied by, if it was not chemically combined with, an acid, and that this acid appeared to form an essential ingredient. For a long time it was considered, that this acid was lactic acid, that is, an organic acid, formed from sugar and from amylaceous food.

The researches of C. Schmidt[1] have, however, fully established the fact, that the acid accompanying the pepsin is a mineral—namely, *hydrochloric* acid, the chlorine of which is obtained from sodium-chloride, when of course this latter is present in sufficient quantity, about which more immediately.

It has been asserted[2] that lactic acid can replace hydrochloric acid "without prejudice to the effect of the gastric juice". This may be accepted as correct if we only consider the mere dissolution of the food; but that it can equal the mineral acid in a more important function is—as our further inquiry will show—most improbable.

Not only is this organic acid liable to easy decomposition, but—as Prof. Bunge, with a thorough comprehension of the physiological principle involved, points out—*this lactic acid is the result of an abnormal digestive process;* it is formed from sugar and from farinaceous substances in the food by means of *a morbid fermentation* (*partly owing to want of sodium-chloride*), *and is not—like hydrochloric acid, the direct product of the digestive organs—a normal secretion.*

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[1] Bidder und Schmidt, p. 44.

[2] Hermann's *Elements of Physiology*, p. 97.

"And if we ask"—citing Prof. Bunge again[1]—"about the significance of this free acid, the answer given by most authorities is: it serves for the digestion of albumen. The various albuminoids and the closely allied glutinous food-stuffs are the only substances in which the gastric juice effects any change. They are converted into peptones . . . and thus enabled to effect a passage through the walls of the intestines for absorption into the blood circulation."

"This peptonisation is effected through a ferment, the pepsin. But the pepsin can only act on the food in the presence of an acid. This is the reason why the acid was considered as necessary simply for the digestive process in the stomach."

"This is, however, not a satisfactory answer, since it is an established fact, that the ferment secreted by the pancreas" (and poured into the duodenum, similarly as, and not far from the spot where the bile is ingested into the intestines) "acts even more energetically in peptonising the albuminoids, than the pepsin, and it does this in the presence of an alkali. Why then burden the cells of the stomach with the formation of a mineral acid from blood, which has an alkaline reaction, when the albuminous nutriments can be changed so much easier by the pancreatic juice? The free acid must therefore fulfil another function."

"Since we know that in *mineral acids* we have the most powerful means of *preventing and checking putrefaction*—have in fact the *strongest antiseptic*—it is natural and logical to surmise, that the hydrochloric acid acts in the character of a protector against putrefaction. It has to perform the task: to kill the micro-organisms introduced with the food into the stomach; which microbes, by initiating a fermentative process in part of the food before its absorption in the intestines and the consequent production of putrefactive substances, can produce not only distressing but also morbid symptoms, and endanger life."

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[1] Bunge, p. 141.

I have cited the above at such length, first, because it is the exposition of the question by one of the latest authorities; secondly, to impress upon you the great importance and the necessity of the presence of hydrochloric acid in the gastric juice; and as a corollary, of the sufficiency of common salt in the blood as a necessary condition for the prevention of disease.

Prof. Bunge relates some practical experiments undertaken by Sieber, Miquel, Schmidt and others, to determine the concentration of the acid solution required for most effectively preventing putrefaction. It was found to be 0·5 per cent.; a higher or lower concentration was not so effective. This corresponds with the average amount found in the gastric secretion of healthy stomachs. To which Prof. Bunge adds: "We arrive thus at the astonishing result, that the concentration of hydrochloric acid in the gastric juice corresponds exactly with the proportion, which is required to check all development of fermentative organisms. This cannot be an accidental coincidence."

It must appear needless to pursue this question any farther, at least for the present, but the following facts will impress themselves lastingly on our memory:—

"A serpent had swallowed a lizard. After sixteen days, Spallanzani opened the stomach of the serpent. The lizard was half digested, but not the slightest smell could be noticed. Spallanzani observed that, not only could the gastric secretion prevent putrefaction, but it could check such putrefaction if already commenced. Putrefied meat, if introduced into the stomach of various animals, lost its diseased properties and also the putrefactive odour."[1]

It can scarcely be doubted that this protection against putrefaction, imparted to the food in the digestive process, extends beyond the digestive canal, *i.e.*, *this immunity from putrefactive changes adheres to the particles of nutriment after being absorbed into the circulation, and that thus a strong blood serum is formed, which possesses immunity against bacterial infection.*

I cannot resist the temptation of directing attention to the fact that, according to the results of researches instituted by many experimenters, man, even with a so-called healthy stomach, among all his fellow-animals has on an average the lowest concentration of hydrochloric acid in his gastric juice. But then we must bear in mind that he is a highly civilised being who consumes large quantities of tea, coffee, soda, potass, seltzer, lithia and numerous other waters, champagnes and other concoctions, without deigning to replace the common salt, which by means of these beverages he has washed out of his system, on the strength of the assurance that the quantity of sodium-chloride, naturally contained in his food, is sufficient for all purposes.

It is very natural here to raise the question, whether it is possible to meet with cases in which the hydrochloric acid is absent from the gastric juice, and whether these cases are so frequent as to account for the many ailments and diseases, which are directly and indirectly due to such absence. Experiments made on dogs have incontestably proved, that abstinence from common salt leads before very long to the disappearance of the acid in the gastric juice, causing, as Dr. Kühner[1] states, the food to be vomited unchanged, and ultimately the death of the animals in consequence of a general paralysis. I have met with a number of persons who purposely avoided salt; they were of a highly anæmic appearance, and complained of the inability of keeping the first morning meal on their stomach, which was the result of the absence of the normal acid in their gastric secretion. A dose of a weak common salt solution, taken fasting before breakfast for a few mornings, relieved them.

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[1] Bunge, p. 143.

Furthermore, direct proof has been obtained by means of the stomach pump, that it is not at all rare to find the normal acid absent. The mere administration of hydrochloric acid is in such cases not effective, as Prof. Bunge has pointed out; it passes through the system without influencing the evil, which it is intended to remedy.[2] He declares that in various cases of illness, the contents of the stomach have been extracted by means of the stomach pump for the purpose of investigating the nature of the gastric juice. It has been found that frequently *the acid was absent but never the pepsin.* He warns against the repeated use of hydrochloric acid, especially in chronic affection of the mucous membrane.

Let me repeat what has already been stated above: it is the absence of common salt and of the normal acid in the stomach secretion, that causes the fermentation in the sugar and the farinaceous food, producing lactic and other acids and subjecting the sufferer to the ailment absurdly called "heartburn". It deserves to be mentioned here that at the meeting of the British Association at Leeds in 1889, Sir William Roberts, president of the section of pharmacology and therapeutics, dealt "with the question of the most effectual means of relieving the pains of that form of indigestion, which is associated with acidity. It will comfort many sufferers to be told that the best antacid for this purpose is furnished by lozenges each containing three and a half grains of chalk and two and a half grains of carbonate of magnesia, and that, in the opinion of the eminent physician, who recommends them, their use is *harmless if controlled by the precaution of taking them only when pain is present*."[1]

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[1] Dr. Kühner, *Krankendiätetik*, Berlin, 1892, p. 17.

[2] Bunge, p. 155.

What is to be said about such advice? If an ignorant layman were to administer two ingredients, which can only (as inferentially admitted) do harm to the system, and are intended to relieve but not to cure the evil, it would be pardonable; but this advice emanates from an *eminent physician*, and is paraded before the public in the first journal of the land. Above all, the "doctor" asks us to believe, that pain can make harm*ful* medicine harm*less;* but such is medical logic, which transcends the plain understanding of common unlearned people.

The Family Doctor (18th Dec., 1897) gives the following advice: "Much benefit is derived from the use of bismuth in heartburn. A mixture consisting of ten grains of subnitrate of bismuth with an equal amount of compound powder of tragacanth in an ounce of water for a dose, is a good mode of administration. If accompanied with pain and eructations the addition of ten minims of hydrochlorate of *morphia* solution, and ten grains of bicarbonate of soda, will be found to give relief." This should excite our enthusiasm ; never mind the cure.

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[1] *The Times*, leading article, 17th August, 1889.

But even the simplest of the above-named more or less poisonous "medicines," carbonate of soda, will, as Prof. Bunge points out, not attack the cause of the evil, but rather lay the foundation for its renewal. Starvation (a little self-denial) until the stomach, through the supply of salt to the blood and the formation of hydrochloric acid, has become disinfected, is the radical cure for the affliction.

In relation to the absence of hydrochloric acid in the gastric secretion, it is a significant fact, referred to by me on a previous occasion[1] when speaking about the natural immunity against cholera, that *about* 5 *per cent. of most communities are found to have an alkaline or neutral, instead of a normal* (*acid*) *stomach reaction.* And this is, so far as the susceptibility has shown, practically confirmed by various observers, about which we shall learn more, when inquiring into the prevention of the infectious diseases later on.

Suffice it here to repeat, that for the prevention of a number of mortal internal maladies, it is absolutely necessary, that the gastric juice contain the normal proportion of hydrochloric acid, and for this it is requisite that the blood be supplied with the necessary amount of common salt.

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[1] *Natural Immunity*, p. 60.

CHAPTER XXI.

SALT AND THE KIDNEYS.

THE life of the human body, from its first beginning to its last breath, may be described as a continuous process of oxidation. The building-up of the whole organism; its growth and maintenance; its activity; even its highest intellectual manifestation; and lastly, its gradual decline and ultimate dissolution are all processes of burning, of oxidation, lasting uninterruptedly throughout our individual lives.[1]

To maintain this process, we have constantly to replenish the various substances, that are thus burnt; we have to supply the body with food for oxidation; and when that food has served in forming part of our organism, has been oxidised, then the product of this combustion must be expelled from the system.

Among the various organic substances, which we require as food, we distinguish two principal classes:—

1. The nitrogenous, the albuminous aliments, of which albumen, the white of egg, is the prototype, and which we find in meat, in eggs, in the leguminosa (lentils, peas, and beans), and in the cerealia (wheat, oats, barley, rye, etc.). These alimentary substances are called "nitrogenous," from the fact that they contain, besides carbon, hydrogen and oxygen, also nitrogen, as distinguished from:

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[1] Moleschott, *Kreislauf des Lebens*, p. 118 *et seq.*

2. The non-nitrogenous nutriments, which contain only carbon, hydrogen and oxygen, but no nitrogen ; to this class belong starch (farinacea), sugar and fat.

The ultimate products of the oxidation of these latter are carbonic acid and water, which are expelled from the system by the lungs, the skin and the kidneys ; whilst the products of the oxidation of the nitrogenous compounds are chiefly, if not entirely, urea and uric acid, which are excreted by the kidneys, and which immediately concern us in the following remarks.

The proper and efficient oxidation of the nitrogenous alimentary substances in our body depends, no doubt, directly on the normal supply of oxygen to the blood, and therefore on the presence of a sufficient proportion of common salt in the system, in illustration of which it deserves mention here that uric acid (the great tormentor of the gouty) is an intermediate step to a higher oxide ; that by a further oxidation of uric acid is formed the ultimate product : urea ;[1] and the presence of the former—the uric acid—may be taken as an indication of a probable deficiency of oxygen for completing this metamorphic process, and as pointing to (besides want of exercise) an insufficiency of common salt in the blood.

But sodium-chloride fulfils another and a far more important office in relation to these retrogressive compounds. We must remember, again, that colloid, *i.e.*, organic substances, cannot pass through the interstices of an animal membrane, unless they have formed a combination with a salt ; and here we find, as Liebig has first pointed out, that urea—a used-up, effete, hence poisonous substance, which should not remain longer in our body than is required for its transport to the kidneys —forms such a compound with common salt, by which it becomes crystallisable and thus capable of being secreted by the kidneys.

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[1] Moleschott, *Kreislauf des Lebens*, pp. 182-3.

In relation to this part of our subject, let us hear what Liebig says:[1] "It is more than probable that it (common salt) promotes, nay, even determines certain changes and operations by virtue of its peculiar properties as a salt. We need only recall the fact that common salt possesses the property, quite unusual among salts, of forming with urea a chemical compound, which crystallises in beautiful, large, clear rhombic prisms, and which is always found in urine containing common salt. Even in the vitreous humour of the eye the urea is accompanied by common salt. By combining with salt urea loses certain properties, which belong to it as an organic compound; and accurate observations may perhaps show, that the absence of urea, the ultimate product of the organic change of" (nitrogenous) "matter, as well as of common salt in the muscular system, and *the passage of urea into the circulation and its excretion by the kidneys, have a closer relation with the presence of common salt in the blood than is generally supposed.*"

And Moleschott confirms this[2] when he remarks: "It is altogether very significant that the inorganic constituents are found in combination with the organic plastic substances, not only in the formation of living tissue, but *they also accompany them in their expulsion from the system as excreta.* Uric acid leaves the body in the urine not as free acid, but as a soda salt." And let us remember that the sodium for this soda salt is furnished by common salt.

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[1] Liebig's *Letters*, p. 407 *et seq.*

[2] Moleschott, *Kreislauf des Lebens*, pp. 168 and 195.

Hence, for want of salt in the blood, urea and uric acid accumulate in the system, and are the cause of many forms of disease. These retrogressive, effete, used-up ingredients sap and undermine the foundation of life itself, in so far as urea destroys the red blood corpuscles, and uric acid appears to be the cause of gout and rheumatic affections. The passage of common salt through the system carries away this disease-producing slag of the organism ; hence we can claim for common salt the name and office of the best, the cheapest and the most natural *blood purifier.*

There is another aspect of the relation existing between the kidneys and common salt, that must be elucidated, as it refers to the whole question of supplying salt to the animal economy.

In a previous part of our inquiry (p. 59) we learnt from Prof. Bunge, that by the administration of 18 grams of a potash salt during twenty-four hours, there is withdrawn from the system 6 grams of sodium-chloride, that is, half the amount of common salt contained in the blood of an adult human being of average size. And this amount of a potash salt, he says, was by no means large, since an adult, who feeds chiefly on potatoes, supplies to his system in twenty-four hours 40 grams of potash. To protect the blood from losing its common salt we should have to add 13·3 grams of this latter, and the kidneys would have to secrete 53·3 grams of the combined salts during the twenty-four hours.

Here Bunge points out the danger of abstracting common salt from the system, as it is "the most essential and necessary constituent of the blood serum" ; he then raises the important question, whether the kidneys are so constructed as to be capable of secreting so large an amount of salt, and expresses the fear, that the addition of common salt to our food, as a condiment, can lead to intemperance in its use. I shall have more to say about this point, when dealing with the question of the quantity required for our daily wants; but with regard to the overburdening of the kidneys by its secretion, I must repeat what I stated in a controversy on the subject in a continental publication a few years ago.

To justify the fear of overtaxing the kidneys, it is assumed that the usual quantity of common salt consumed per day per head is about 25 to 30 grams; but from my own experience this is much too high, as I shall show later on. I myself have consumed on an average about 15 grams, all sources of supply considered, and have never experienced any evil results from that quantity, never in fact suffered in the slightest degree from disordered kidneys.

It entirely depends how much of it is taken at one time, and even then it will be gradually absorbed and diffused through the blood and excreted by the kidneys, as the various portions of the blood pass through the latter. Whatever quantity may be taken at one meal, it has—since the addition of salt takes place at one or two meals—from ten to sixteen hours' time for its gradual elimination from the system.

It is an interesting question whether people, who live chiefly on potatoes—as for example the people of Ireland—show a greater tendency to kidney disorders. Prof. Bunge thinks that a diet of potatoes, with the necessary addition of common salt, requires the elimination of over 100 grams of alkali salts through the kidneys during the twenty-four hours, and he fears that this should lead to a serious disturbance in these organs.

We must not forget that all excretion of salt by the kidneys is accompanied with the elimination of water; and that the water, so abstracted from the system, will remind us by the feeling of thirst to make good the loss, and that thus we can understand, that the kidneys can easily excrete the quantity of salt, which, taken during the twenty-four hours' seems large, but for each moment that the kidneys can be active, appears not so extraordinary.

Taking the density of the solution at 1 per cent., it would require 2000 ccm., *i.e.*, 2 litres (equal to a little more than 3½ pints), of water to eliminate 20 grams of salt through the kidneys during the twenty-four hours. But it is not improbable that the kidneys can secrete salt solutions of a higher density; and 3½ pints of water passed through the kidneys during a day, is by no means an abnormal amount. So that, on the whole, there would seem to be no cause for fear of damaging the kidneys. And direct experiment confirms this view.

Heidenhain[1] reports that Bock and Hoffman injected during nine hours gradually 3200 ccm. (about ¾ of a gallon) of a 1 per cent. common salt solution direct into the blood circulation, and the kidneys excreted during that time no less than 2304 ccm., equal to 256 ccm. per hour, and the urine retained up to the last its normal composition. That is, the kidneys secreted from the blood in nine hours 23 grams of salt, 2½ grams per hour, or at the rate of 60 grams per twenty-four hours, without any detrimental result.

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[1] Heidenhain, Hermann, v.a, p. 333.

The question presents, however, a different aspect when salt is withheld from the system, or when the blood is surcharged with plain water. Heidenhain informs us further[1] that the kidneys are highly sensitive to an increase of water in the blood (which is equivalent to a decrease in the proportion of salt). "*As in the case of the bile so also in the urine, a high degree of watery condition of the blood causes the appearance of albumen in the secretion.*"

Dr. J. Forster,[2] when insisting on the absolute necessity of the inorganic ingredients for the maintenance of life, points out that the withholding of even one of these ingredients from our system can cause serious disturbances and endanger the continuation of our organism. In illustration of this he cites the experiments which Prof. Wundt made upon himself. Wundt abstained from common salt for five days, during which he secreted the

1st day	7·21	grams
2nd ,, ...	3·62	,,
3rd ,, ...	2·44	,,
4th ,, ...	1·36	,,
5th ,, ...	1·09	,,

of common salt. But on the third, fourth and fifth days he found that *the urine contained albumen*, and continued to do so for other two succeeding days, during which he renewed the addition of the usual quantity of sodium-chloride.

This not only confirms Heidenhain's above statement, but it most distinctly proves that *abstinence from common salt* causes the appearance of albumen in the urine and thus the commencement of more *serious affections of the kidneys.*

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[1] Heidenhain, Hermann, v.a, pp. 275 and 332.

[2] Dr. Forster, *Z. f. Biologie*, vol. ix., p. 306.

More injurious appears to be the effect when water is injected directly into the circulation. MM. Richet and Montard-Matin[1] made some researches "on the effect of injecting various substances into the veins, which were reported to the Academie des Sciences. They find that distilled water, injected into the veins—far from being, as might have been anticipated, diuretic—*arrests the ordinary secretion* even when the quantity thrown in only amounts to 10 grams for each kilogram of the total weight of the animal. In smaller quantities, as 5 grams, it checks without arresting it. *In larger quantities it permanently arrests the secretion, and the function of the kidneys cannot be re-established.*"

All investigations hence, prove that common salt is the chief agent in the secretory process of the kidneys; that *the system cannot relieve itself even of superfluous water through these organs, unless salt is present to stimulate the kidneys to normal activity; and that, for want of salt in the system, the secretory action of the kidneys can be more or less checked and ultimately ruined.*

When we further consider that the life of the human body depends upon the constant oxidation of the albuminoid substance, that hence the retrogressive compounds, such as urea and uric acid, are constantly formed—whatever the quantity of salt in the blood—that these for the healthy condition of the organism require to be expelled from the system, and that this process is determined, or is principally assisted by sodium-chloride—considering all these facts, it must appear to us more than probable that, in consequence of a diminution of sodium-chloride in the blood, the urea and uric acid will be retained in the body and be the direct cause of diseased kidneys, besides producing, through their accumulation in the blood, other serious morbid conditions.

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[1] *Lancet.* (Copied into the *Scientific American*, 27th March, 1880, p. 200.)

We ought to be in fact more alarmed by the action of the retrograde organic compounds in the kidneys, owing to a deficiency of common salt, than fear the too abundant presence of the alkaline salts.

I have dwelt upon this part of our subject rather long, knowing and being convinced that this so-called overtaxing of the kidneys, through the excretion of a relatively large quantity of alkali salts, is the only scientific objection, which can be raised against the judicious and liberal use of common salt; and here we find that all evidence goes to show, that the kidneys suffer more from abstinence than from a rational use of common salt.

We find another confirmation of the evil effects of an abnormal supply of water to the system on the heart and the kidneys in the statement of Dr. Bollinger, director of the anatomico-pathological institution in Munich (see *Family Doctor*, No. 664, p. 178), "that it is very rare to find a normal heart and normal kidneys in an adult resident in that city. The reason for the kidney disease is the tax upon these organs by the drinking of an excessive amount of beer, and the cardiac hypertrophy and degeneration are secondary lesions for the most part."

To which I have only to add, that it is not so much the drinking of beer (on the whole consisting of water, with a small amount of organic substances) as it is the deficient supply of common salt to assist and promote the elimination of the large quantity of water by the kidneys, which is the ultimate cause of the degeneration of the latter organs.

But what are we to say in face of this destructive tendency of plain water on the kidneys—as well as on the rest of the animal organism—to the following advice, which is offered with the unction of a superior knowledge, by a popular medical journal to a large circle of the general public?[1]

After questioning the consumption of the natural mineral water at the "mineral water health resorts" in such large quantity, the writer continues: "The secret of the cure is in the quantity of water taken. If the water be pure, free from organic matter and taken in sufficient quantity, the results will be substantially the same regardless of the traces of lithia and small quantities of sodium-chloride and other salts. You can perform these cures at home with the ordinary drinking water, if of good quality, if you will require the patient to take it in the same quantity as at the springs. It is very easy to add lithia if desired, but you must not lose sight of the fact that the quantity of water (not lithia) taken, is the important thing. It acts by flooding the kidneys," etc., etc.

If the writer by this advice ruins the kidneys of his readers, should they follow his injunction, we can but pray: "forgive him, he does not know what he is doing". We cannot arraign him for manslaughter as he might deserve; but a public teacher (a doctor) should make himself acquainted with his subject, and know, that such flooding of the kidneys with even the purest water will unavoidably ruin the kidneys, unless the blood is supplied with a corresponding amount of sodium-chloride.

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[1] *Family Doctor*, 25th Sept., 1897, p. 52.

CHAPTER XXII.

COMMON SALT *VERSUS* WATER IN THE HUMAN BODY.

In a previous part of our investigation we have learnt, that plain water has a destructive action on the tissues of our body, and that this destruction is prevented and checked by the presence of common salt. So that, although a great affinity exists between these two inorganic substances, yet there seems to be a kind of opposition exercised between them ; or, shall we say, they act upon each other as moderators ? the destructive tendency of the water is moderated by the presence of common salt, and the irritating action of the salt is subdued by the softening influence of water ; thus at all events we find them act in the human body.

Whatever beverage we take it is chiefly always water ; whether it is tea, coffee, cocoa, wine, beer, soda, seltzer or other mineral waters, and even alcohol, which can—at least as a beverage—only be taken diluted ; all these supply the body with water, and the various secreting organs, the lungs, the kidneys and the skin, are constantly required to relieve the system of the superfluous liquid. The result of the immoderate imbibing of water is only too evident ; its accumulation in the body—besides inducing the deposition of fat and soaking into the tissues, especially the muscles—causes the greatest distress after the slightest physical exertion, and produces, as we have seen, heart failure in its various forms, besides many other morbid and mortal affections. And all these symptoms are the result of an insufficient supply of common salt.

As already pointed out, the abstinence from salt can deprive the blood of this constituent down to the absolute minimum with which the blood cannot part without the risk of its own destruction ; but it is not certain whether the tissues of the body have retained salt in the same proportion. We shall in the further pursuit of our subject come across phenomena which would indicate, that this is not the case, that, *viz.*, the tissues have parted with common salt much below the minimum proportion in which it is retained by the blood.

The quantity of water, contained in the muscles, has been the subject of inquiry, and its greater amount has been considered to be the cause of an increased susceptibility for a certain class of diseases. In an article on cholera Prof. Max von Pettenkofer[1] is, I believe, the first who pointed out this fact: that those most liable to the disease are distinguished by an increased amount of water in their muscular tissues. He cites from the researches of Ernest Bischoff the following figures to support his remarks: "The muscular tissue of a newly born infant contained 82, that of a powerful man thirty-three years of age (decapitated) 75 per cent. of water. Not only in animals but also in man do we find, that the greatest muscular efficiency coincides with the least amount of water in the muscular tissues. Prof. Ranke informs us, that tetanus is always connected with a considerable proportional loss of solid matter in the muscular tissue, which is *the result of an augmentation of water.*"

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[1] Prof. Max von Pettenkofer, *Z. f. Biologie*, vol. ii., pp. 94-95.

We have already considered the heart in relation to a watery state of the blood, how the muscles of that organ must suffer when soaked and loosened in their fibres; their contraction cannot be performed with due regard to their work without rest, without intermission for recuperating their strength, even after the slightest exertion; and that hence the heart suffers more immediately than any other organ from an abnormally watery condition of the blood.

And also the brain suffers. In an article on the relation of water to the grey matter of the brain, Max Hubrich[1] states that he discovered, when preparing segments of brain with a knife moistened with water, minute vesicles; but when using a 0·7 per cent. common salt solution, even so low a solution as 0·2 per cent., these vesicles did not make their appearance. This discovery was confirmed by Prof. Buhl,[2] who observed such water bubbles in all cases of meningitis in children as well as in adults, and, according to his experience, they do not appear in this disease (meningitis) only, but also *in every brain which is distinguished by the presence of an abnormal quantity of water.* He considers them to be particles of albumen soaked with water, a condition which can only exist in the absence of sodium-chloride.

We must further observe that a watery state of the system generally also affects the nerves; these become more sensitive to changes of temperature, lethargic in conveying impressions to the brain, and consequently also in muscular and organic reflex action. The entire nervous system becomes sluggish, enfeebled, and imparts to the whole system, through its inert influence, a greater susceptibility to disease of a character such as influenza.

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[1] Max Hubrich, *Z. f. Biologie*, ii., p. 394.

[2] Buhl, *Z. f. Biologie*, ii., p. 396-397.

A remarkable instance of the deleterious effect of plain water on nervous sensibility is the following:—

"Weber has proved by experiment that, when the tongue has been immersed for only one half to one minute in plain water of a temperature a little over blood heat, it has lost its capacity of tasting sugar".[1]

Dr. Gustav Jaeger,[2] whose name is so well known in connection with woollen underclothing, made experiments extending over several years, to prove: that a high specific gravity of the body imparts a corresponding power of resisting disease. And this condition he showed could be obtained by withdrawing water from the organism. He actually measured the effect by comparing mental efficiency, the alertness of observation by means of our senses, as also muscular exertion under varying conditions of the system as to the body's weight when compared with its bulk, estimated before and after a period of systematic exercise.

And although the destruction of fat had also an influence on the improved condition, Dr. Jaeger's investigations (which are on the whole very instructive) brought out the fact that a de-watering, a draining of the system, *i.e.*, the abstraction of water from the tissues, was the most effective means of imparting this resisting power to the body.

There are several means at our disposal for effecting this de-watering process: exercise, which, without becoming violent, expels the water in the form of vapour through the lungs ; or, when more vigorous, as perspiration through the skin ; next the hot-air bath ; and lastly, the administration of common salt in measured quantity. The salt acts as a diuretic, extracting the water from the system through the kidneys, and by thus maintaining the proportionate density least harmful to the tissues, it protects these latter against the destructive action of the water.

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[1] Hermann, iii.b, p. 219 and pp. 204-205.

[2] Dr. G. Jaeger, *Seuchen-festigkeit und Constitutions-kraft*, Leipzig, 1878.

Salisbury Diet [illegible] [illegible]
use of at least [illegible] pints per day
Taken between meals. [illegible]
by the [illegible] [illegible]
[illegible] can be noted
that [illegible] [illegible]
[illegible] [illegible]

CHAPTER XXIII.

SALT AND THIRST.

THE very mention of salt awakens in the mind of most people a vivid idea of thirst, and I invariably meet with doubt, when I assure inquirers that, when the body is charged with salt, when all the tissues are bathed with the normal saline solution, thirst is not experienced to the same degree as in cases of saline abstention.

The reason of this is easily understood. Any one withholding from salt or merely accepting what nature and the cook have put into the food, is sure to experience the more or less keen sensation of thirst, whenever a little extra quantity of the mineral is added to the food; whilst I know from practical experience that with a fair amount to make the food tasty, I can go through the day without any beverage and without any desire for liquids and certainly without being tormented by thirst.

Not only this, but if after a meal of salt fish or salt meat an unusual thirst should—as with salt abstainers no doubt would be the case—arise, when repeated draughts of plain water fail to quench this thirst, it will yield to half a glassful of the normal saline solution (that is: one-half to one part of salt in a hundred parts of water). Do not let me be understood to say a word in favour of highly salted food. I would rather have these articles banished from the list of aliments for human beings. Salt added to food in such quantities, as it exists in pickled meat and salt fish, seriously interferes with the digestion. Necessary as it is in the saliva and the gastric juice, it impedes the solution of food if present in even so weak a proportion as 2 to 3 per cent. (See under "Salt and Digestion" for the proportion of salt normally present in the stomach secretion.)

The degree of thirst, produced by the addition of salt to our food, depends not only on the quantity so added, but also on the proportion in which it is present in our body. There is, however, an astonishing difference in the result between salt taken with food and the same amount taken in solution with water. In the latter case the mixture may taste strong of the saline ingredient, yet it will not excite thirst. And this points directly to the best manner in which we can—and I venture to say, should exclusively—supply this mineral food to our system, about which more farther on.

But thirst is not only produced by the use of salt, as Dr. Andrew Combe remarks.[1] He says: "Many persons without experiencing any real thirst, habitually indulge in potations of water or beer at all hours of the day and to an extraordinary extent and feel unhappy when suddenly restricted in their indulgence. But this temporary discomfort ought not to be considered as indicating that these potations are really necessary."

There exists to a great extent a popular aversion if not a contempt for drinking simple water. People who are in the habit of drinking nothing "stronger" than unadulterated water, are intuitively looked upon as possessing no physical stamina, as weaklings, who cannot bear a puff of wind or a sustained physical exertion without unduly suffering. According to what we have learnt about the depressing effect of water on the system—unless the latter is adequately supplied with common salt—there is perhaps some truth in it. Unfortunately this aversion to water finds a practical but not commendable expression in adding alcohol to the water, or replacing the latter mixture by wine, beer or other fermented beverages, thus undermining and sacrificing the health for a moment's excitement and in the belief of gaining physical strength.

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[1] Dr. Andrew Combe, *Physiology of Digestion*, 3rd ed., p. 51.

It would be conferring a great boon on thirsty humanity, and might possibly assist in the conquest of alcoholism, were a beverage "invented" which contained, let us say, even ½ per cent. of sodium-chloride in combination with carbonic acid or other ingredients, which would make the "drink" pleasant and exhilarating without detriment to the system. It might not have the same immediate irritating and exciting effect as a "cock-tail" or an "eye-opener," such as only a depraved stomach can possibly bear; but it certainly would have the highly desirable and hygienic effect of furnishing the sodium-chloride, which is required for the expulsion of the water (in the "drink") through the kidneys: and, from what we have learnt above, it would keep the blood in a healthy condition, promote the life's flow of all the vital juices, and thus ultimately invigorate the system instead of leaving it weaker.

Certainly: the objection that salt produces thirst—advanced for the purpose of proving the harmfulness of taking that inorganic food—has no rational basis. All facts go to prove that, with a proper management of the system, a rational use of salt will rather assist in controlling thirst.

By all means quench your thirst, but do not forget the common salt.

"He that goes to bed thirsty, rises healthy."

"Eat at pleasure; drink by measure."

Hufeland, in his *Art of Prolonging Life*, gives among the attributes of a man, to live long, the following: "He eats slowly, and has not too much thirst; too great a thirst is always a sign of rapid self-consumption."

And I will end this subject with an extract from Dr. Kitchiner's *Art of Invigorating and Prolonging Life* (p. 165): "Happy are the young and healthy who are wise enough to be convinced that *water is the best drink and salt the best sauce*".

CHAPTER XXIV.

SALT AND SCURVY.

ANOTHER idea connected with common salt in the popular mind is the fear of scurvy. Although researches about the causes of this disease have now completely refuted this belief, it is nevertheless still advanced as an objection against the use of salt.

This idea, that scurvy is caused by salted meat, if not by the general use of common salt, had its origin in the outbreak of this disease during long voyages, when salt beef formed one of the chief staples of food ; and nothing was more natural than to ascribe the cause of this to an excess of sodium-chloride in the meat. But it has been ascertained beyond all doubt, that the malady is the result of "the continued use of a dietary deficient in fresh vegetable material. Scurvy only occurs when fresh vegetable nutriment has been for some time partially or completely withheld."[1] And to give especial emphasis to this assertion—not only to prove its correctness, but also to show how unfounded the above-stated popular fear actually is—let us hear what practical experience can teach us.

"The Turks in the Mingrelian campaign of 1855-56 had no salt meat, and suffered much more severely from scurvy, than did their French and English allies at a time when the latter were dependent upon it for animal food."[1]

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[1] Dr. Th. Buzzard, Reynolds' S. *of Med.*, ii., pp. 731-732.

A still more positive proof that salt is not the causative agent in the production of scurvy is found in the case of a gentleman of the legal profession, who was cured by the administration of common salt in combination with port wine;[2] and nothing can serve better to give the death-blow to this false popular notion about the evil effects of common salt than the fact, that the Admiralty has ordered a supply of salt for the use of the seamen in the navy (see the daily papers of October, 1897).

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[1] Dr. Th. Buzzard, Reynolds' *S. of Med.*, ii., p. 738.

[2] I am confident of having read this statement in a medical work, and as far as my memory serves me, it was related by a Dr. Thompson; but I submit to correction.

CHAPTER XXV.

SALT AND CANCER.

I DARE not leave unnoticed the assertion, so repeatedly advanced against the use of common salt, that it produces cancer. I am not aware upon what fact this assertion is based, unless it is the presence of sodium-chloride as the major portion of the inorganic ingredients in cancerous growth. Nor am I able to say whether this dictum had its origin in the mind of a physician or a layman.

Made under a complete misapprehension of the nature of the disorder and probably with the joyous pride of a brilliant discovery, it has been copied by the penny-a-liner of the daily and weekly press only to pander to public fear by a sensational statement.

It is no doubt the want of definite knowledge about the cause and origin of cancer, which prevents the medical profession from exposing the unfounded character of the above opinion ; but a little reflection and the recollection of Harvey's biological dictum, "*omne vivum ex ovo*"; or the later axiom, "*omnis cellula a cellula*," should guide us in giving a scientific answer to such a popular belief.

Cancer is an abnormal growth, a pathological cell formation, which feeds on and destroys the normal cellular tissue of the human body. It starts with a germ cell, and the question before us is the origin of this germ cell. It cannot have arisen *de novo*; such cell formation does not occur; all new cells are the descendants of old cells.[1] The disease germ of this new growth must either be introduced into the system from without in the food, or it must develop itself out of the cellular life of the organism under the influence of abnormal morbid conditions.

The question then before us is, can the presence of common salt, of course in its maximum proportion, be the cause of the normal changing into an abnormal, a heterogeneous, a diseased cell formation?

It is out of place here to enter into an inquiry about the etiology of this terrible affliction, as the question of its local or constitutional origin is still a point of contention, although the greater number of physicians incline to the former opinion. But medical science and art, beyond the possible, yet often questionable prevention by means of excision of the developed germ at the initial stage, stands helpless at the bedside of the suffering patient.[2]

The researches of Dr. F. W. Beneke make it appear as highly probable "that the development of cancer is promoted by a condition of the system, which is distinguished by an abundance of the phosphate salts and of the albuminates, and which is productive of an excess in the creation of bile and of cholesterine".[3] And this seems to be confirmed by what Campbell de Morgan lays stress on, that, namely, cancer develops by preference in persons who appear strong and healthy, and that the disease has not its origin in a want of food or of tone in the system.[4]

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[1] Prof. Virchow, *Hundert Jahre Allgemeiner Pathologie*, p. 32.

[2] Dr. R. de Villiers, *University Magazine*, Dec., 1897, p. 225 *et seq.*

[3] Beneke, *Bal. Br.*, p. 29.

[4] *Ibid.*, p. 31.

Practical evidence therefore goes to show (without touching the question of the origin of the morbid cell germ) that a superabundance of all those substances, which are required in the body for cell formation, produces the condition for the morbid cell growth. But all practical experience in, as well as outside the body has proved sodium-chloride to act above all as a preservative, as an anti-putrefactive, as a substance which imparts stability to organic compounds, and thus it would appear that not its abundance (we must remember, as stated already, it cannot exist in excess; the kidneys secrete all amounts above 6 per 1000), *but its deficiency, as compared with the predominance of the albuminoids and the phosphates*, causes the abnormal morbid cell formation and affords the pabulum for feeding the disease.

Prof. Beneke indirectly points to this fact when he says:[1] "The means to be employed are: a thorough dietetic treatment of such a nature, that the nutriments rich in nitrogenous and phosphatic compounds (such as eggs, meat, milk, leguminosa, wheaten flour) are reduced to a decided minor proportion of 1 to 9 or 1 to 10 of non-nitrogenous substances; lowering of the liver's activity by dietetic as well as medicinal means (*Carlsbad* and *Marienbad Waters*)".

These waters contain chiefly common salt and Glauber's salt in about equal proportion, and both act most beneficially on the liver in the secretion of bile.

And he further directly refers to the benefit of sodium-chloride in counteracting the effect of an excess of albumen:[2] "If we supply to our organism daily a quantity of common salt—a little more than usual—we increase thereby the metamorphosis of the nitrogenous (*i.e.*, the albuminoid) substances of our body, as also the amount of urea secreted by the kidneys ".

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[1] Beneke, *Bal. Br.*, p. 67.

[2] *Ibid.*, p. 27.

And thus we find that by a judicious administration of common salt to our system, we forestall that condition of our blood, which is the necessary factor for the formation and the development of a cancerous cell growth.

If, finally, we find that, according to Lehmann's analysis,[1]

Blood contained in 100 parts of fluid . .	0·424
Chyle	0·531
and Scirrhus of the breast (cancer) only . .	0·314

per cent. of common salt ; and when we further remember that common salt forms the major portion among the soluble mineral ingredients (the ashes) of almost all organic compounds, we are justified in answering :—

Common salt, far from being the cause of cancer, is on the contrary, by its presence in the human organism, a preventative, in so far as it checks the abnormal changes of the albuminoid compounds, promotes their normal metamorphosis into urea and the excretion of this latter through the kidneys ; and further, as an alkali salt it interchanges with the phosphates, and thus incites to their excretion. But there is another point which must not be overlooked. When dealing with the question of digestion, we learnt, that the gastric juice which contained the normal hydrochloric acid, gave to the digested food a stronger vitality, a stronger constitution ; and we cannot be far wrong when we assume, that this stronger constitution gives to each organic particle a greater power for performing its part in the healthy life of the organism, than when the mineral acid is absent. And, as we know, that acid depends upon the presence of common salt.

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[1] Lehmann, vol. i., p. 435.

The relation of the presence of hydrochloric acid in the gastric secretion to cancer gains in importance by the fact that Van der Velden [1] found absence of this acid in the stomach in cases of cancer. From this it would appear, in support of the above contention, that in the digestive process the acid imparted a disease-resisting power to the food, and that this power maintained itself throughout the passage of the organic compounds through the various morphological changes in the system.

It is a significant fact, which deserves mention here, as it supports above remarks to some extent, that hydrochloric acid, in combination with tincture of bark, is found beneficial in cases of cancer.[2]

And lastly, it is consoling to learn that there are persons "who, without any operation, have borne the burden of a scirrhus of the breast for fourteen or fifteen years, and it has gradually wasted away, so as to cease to be any source of pain or anxiety; they show us that there is a power in nature which may recuperate her lost balance; and the study of such cases will help us in the way of bringing art to her aid".[3]

Prof. Beneke, when citing this statement of Mr. Weedon Cooke, adds, "that such facts encourage us not to despair of the curability of cancer".

Whilst dealing with this no doubt highly-important subject—important from the fact of its alarming increase and of the fearful suffering which it inflicts on the patient —I venture to suggest for the further consideration of pathologists, whether the eating of *unboiled* or *half-cooked fertilised* eggs—eaten perhaps without the addition of salt or without hydrochloric acid in the stomach —may not account for the introduction of the heterogeneous, the morbid germ cell, which forms the starting-point for the cancerous growth.

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[1] Germain Sée, *Lehre von Stoffwechsel und von der Ernährung*, Uebersetzt von Dr. Max Salomon, Leipzig, 1888, p. 200.

[2] T. Weedon Cooke, *On Cancer*, London, 1865, p. 52.

[3] *Ibid.*, pp. 8 and 9.

But here again protection would be afforded by the presence of the normal mineral acid in the gastric secretion, and (for the formation of this) by the presence of common salt in the blood.

CHAPTER XXVI.

SALT AND THE NERVOUS SYSTEM.

AMONG the objections raised against the use of salt must be named its assumed destructive action on the nerves; and a paragraph which appeared in a number of weekly publications to that effect might be harmless but for the want of any knowledge about the subject among even the presumably best educated portion of the general reading public.

The tone of certainty with which the information is offered and advice is given, causes the ignorant reader to take this as gospel, thinking that the information would not be publicly advanced, had the writer not a scientific basis for his statements.

The paragraph can be traced, I think, to the *Family Doctor*, a weekly periodical which beneficently offers to its readers a great deal of good, and sometimes very practical advice on the maintenance of health; it is thus one of the intermediaries between the profession and the laity, since medical literature is mostly exclusive, *i.e.*, intended for those only, who are initiated in the mysteries of medicine.

The writer, under the heading, "The Salt Habit" (*Family Doctor*, 9th October, 1897), offers the following information. After very justly warning against—what is in every one's mind who wants to talk learnedly about it—*the excessive use of salt*, the writer enumerates "some of the evils of this excessive use. They are, to paralyse the nerves of taste, or to pervert them, so they cannot enjoy anything that has not a salty flavour, and in addition there is a direct tax on both the skin and the kidneys in removing it from the blood. Whether the skin is harmed by this tax" (? ?) "we do not know. Possibly it is not greatly injured, yet we know that few people possess a healthy skin; but it is now pretty well settled that an excessive use of salt does overtax the kidneys in its removal, and that the great number of cases of derangement and disease of these organs is due to this use."

And the paragraph concludes with the advice "to try and diminish the use of this condiment" [*sic*] "so far as possible".

It is difficult from the context to decide what this last sentence means; but I do not doubt that it will induce most readers of it to abstain from all salt, since no guide is given about the "diminution as far as possible".

I do not hesitate to assert, that this advice is most dangerous. It is no doubt very praiseworthy to warn against the use of salt in *excess;* but what is excess? To warn like this is a cheap way of appearing wise. It is like setting up airy opponents and blowing them down with extended cheeks.

About the quantity of salt required and how it should be taken I shall give information further on, where the warning against its use as also against an excess will be answered.

How groundless the fears are, which the *Family Doctor* raises about the overtaxing of the kidneys, has already been answered; and this teacher of the laity will be surprised, no doubt, to find, that according, not to the statements of a layman or the assertions of a quack, but to the result of careful experiments of physiologists, the kidneys cannot even excrete water, unless sufficient salt is present in the blood; and that a good meal of potatoes taxes the kidneys more by the required excretion of the potash salt than a day's supply of common salt—taking this even as high as 25 grams (a little less than one ounce).

With regard to the overtaxing of the skin, it is an ascertained fact, that the system loses less salt in proportion to the water, in fluid perspiration than through the kidneys. Besides, I should certainly fear the consequences if the doctor could deprive English women of their salt; their skin would assume a greyish, unwholesome colour, and they would certainly and quickly resent the advice, to discard the best natural factor for a healthy, rosy skin.

The destructive action of water on the nerves, and the amelioration of this action by means of sodium-chloride, have already been the subjects of our inquiry, from which we have learned, that instead of causing paralysis or perverting the nerves, common salt has a contrary effect: it protects the nerves from the deteriorating, almost killing influence of a watery blood. There is, however, direct evidence that salt has not the asserted paralysing effect on the nerves of taste (see *ante*, p. 128).

The more we learn about the relation existing between salt and the animal economy, the more are we forced to admit, that the normal saline solution of 0·6 per cent. is the element in which all the vital functions can best be performed; and that this is the concentration of the solution least harmful to the organism.

It would be strange were nervous tissue to make an exception to this general diffusion of common salt in the human body, and there is direct evidence that that is not the case.

First then as to the amount of common salt met with in the nerves: we learn from Moleschott[1] that von Bibra found on an average about 2 parts of sodium-chloride in 1000 parts of nervous matter. In the brain and spinal marrow the amount of mineral ingredients is stated as high as 9·50 per cent. as the average, of which common salt forms no inconsiderable part, although less in proportion than in the blood, as the brain is rich in other salts, chiefly phosphates. Later researches have confirmed this. Prof. Drechsel[2] obtained as a total quantity of ashes (mineral—incombustible ingredients) from the various parts of the nervous system, on an average 10·1 per cent., in which common salt was in proportionate quantity.

But of far greater importance is the effect, which plain water and the normal saline solution have respectively on the condition and the functions of the nerves.

Prof. Hermann[3] informs us that, "According to Kölliker and Birkner the swelling of nerves in plain water or in *highly diluted* salt solutions gradually reduces the excitability until completely annihilated". On the other hand, "a certain degree of water abstraction,"—which, as we know, can be effected by a salt solution, and "which in itself does not excite the nerve, will raise its normal excitability considerably"—as Harless and Birkner have observed, and of which every experimenter can easily convince himself. This natural excitability is not destroyed until, through continuous drying, the nerve has lost—according to Birkner—nearly 40 per cent., and according to Ranke 19 per cent. of its normal amount of water.

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[1] Moleschott, *Physiologie der Nahrungsmittel*, Table XXIX., p. 27.

[2] Drechsel, Gehirn und Nerven, Hermann, vol. v.a, pp. 578 and 585.

[3] Hermann, vol. ii.a, p. 97 *et seq.*

"Hence, indifferent, non-destructive fluids, *i.e.*, such in which a nerve can remain for a prolonged period without damage, must, as with muscle, be above all of such a nature, that the nerve neither loses nor gains water to any considerable extent. Kölliker found this to be the now so well known and universally used 0·5 per cent. common salt solution."

Here then we find, that the maximum percentage in which sodium-chloride is or should be present in the blood and above which the blood will not retain it, is also the most suitable concentration for promoting the healthy condition and the normal function of the nervous tissue; and either abstraction from, or absorption of water by the nerves leads at first to excitation, and if continued, will cause (perhaps perversion, but) ultimately paralysis and death. Whatever we have hence learnt about the effect of salt on the nervous system goes to prove that sodium-chloride, in normal solution, far from having a deleterious effect, is necessary for the health and life of the nervous system.

It is futile to lose another word about the paraded "excessive use of salt". If any one will be so childish of taking dry common salt into his mouth, or of over-salting his food, he must suffer for it and learn by experience; but we cannot accept his opinion about the "perversion" and the paralysis of the nerves through the rational use of this mineral food, as a guide. The small quantity which is ordinarily added to the food at the table (even the amount which would make the food taste of salt) can never have a paralysing effect ; whereas the poor being who, for want of salt in his system (about which see "Merely a Cold"), is almost chronically suffering from a cold in his nose, experiences greater paralysis of his nerves of taste, because he cannot taste or smell anything at all, than the person who supplies his system with a judicious amount (about which see later on) of common salt, and thus keeps the nerves of his organs of taste and of smell in normal active condition.

It is worth noticing that "the Mexicans eat salt with their oranges, both because they prefer the fruit so seasoned, and because it is considered to be more wholesome with salt" (see *Family Doctor*, No. 683, p. 74).

A pinch of salt, the size of a hemp seed, added to a cup of coffee will bring out the flavour of the latter ; but it would be ridiculous to declare this addition to be dictated by a perverted taste for "salty flavour".

In justice to the *Family Doctor* it is right to mention, that in a later number than the one, in which the above paragraph appeared, we meet with the following really very important statement in praise of salt: "By the passage of salt through the body the absorption of food is stimulated, and the activity of tissue changes and growth is increased".

This insertion is, however, a poor reparation for the harm done among its readers ; for, this item appears among "Interesting and Scientific Facts" between two others, one referring to the Sultan's table expenses, and the other to the taming of rats ; of so little importance is the subject considered by the *Family Doctor* (No. 676, p. 375).

I have noticed this information, offered to its readers by the *Family Doctor*, at some length for the following reasons: I believe I am correct in assuming, that the editor and the contributors of this paper are all members of the medical profession; at all events, the exclusive character, shown by medical men in all other matters, justifies this belief.

The general public, who only go to the "doctor" when ill, and naturally will not do so in order to obtain information about the means of preventing illness, look, in ignorance about the matter, upon the contents of such medical publications as gospel; and this is evidenced by the many other journals, who copied this alarming advice about common salt destroying the functions of the nerves of taste. When "doctors" will be, what this title conveys, "teachers" of their ignorant lay brethren, it is not demanding too much, that the information offered to their readers should be correct and up to the latest results achieved by physiologists; and if this is not the case we are justified in laying the shortcomings and imperfections of the information and advice at the door of the medical faculty at large, unless the latter will repudiate such publications (which are intended for the lay, and not for professional readers) by declaring them to be literary, if not commercial undertakings, outside the etiquette and beyond the reach of the written or unwritten laws of the faculty.

The unlearned layman has, however, not the means of discriminating in such questions and blindly follows advice which comes "from so high an authority".

The above remarks serve also to justify the appearance of this treatise with the object of disseminating among the general public some correct information on the relation of common salt to our physical well-being.

CHAPTER XXVII.

OTHER OBJECTIONS TO THE USE OF SALT.

THERE is to my mind no existing valid objection which can reasonably and scientifically be raised against the judicious use of common salt. Of course I say "judicious". The most wholesome, the most benign factor for our well-being and for our existence can become injurious and dangerous if abused; but it is incomprehensible with what emphasis the use of common salt has been cried down, or been warned against, or, mildly expressed, has been ignored, from professors of physiology down to the medical touters and the fanatics among the vegetarians.

During the twenty-six years of my study of the subject, I have not met with one reasonable statement about the harm, which the even liberal consumption of salt can have on the human organism; and in works on physiology the objection has invariably taken the simple form of the opinion that we receive in our food, in its natural condition, already sufficient common salt, to make a further addition unnecessary.

We meet, however, not only with disapproving, but also with positive, prohibitive language; and the alarm, which was sounded some years ago, was caused by a work entitled: *Salt the Forbidden Fruit*, by Robert Howard, M.D. It is almost impossible to judge this book fairly owing to the want of logic and ordinary observational powers of the writer.[1]

He declares: "It has now been fully ascertained that, however rigidly salt is abstained from, it is notwithstanding now *generated* in animate blood. Thus salt is continually being generated anew by the process of animate life; the excess of salt, now in the world, is the product or *the fruit of animal life*, deposited in undue and destructive quantity on the earth, and this accounts for the great collection of salt in the sea and in the beds or mines," and he calls the Bible in support of his science, as it is stated therein "that a time was when human beings swarmed on all the lands as grasshoppers do now in the old world. Thus the eating of salt, as we now have it, amounts to the absolute eating of death itself, for the salt we now use, is not even directly to us a product of the earth, but the product or the fruit of the bodies of animated creatures that have lived before us."

To prove how deleterious common salt is, he points to the evil effects of *calomel* (chloride of mercury), which "has proved a terrible curse to society"; and the Egyptian ophthalmia he ascribes to be "due to the extremely saline impregnation of the earth and air of Egypt," as it is "evidently the cause of many diseases amongst the human race".

"The vapour of the acid of salt, which in medicine is called chlorine gas, is most destructive to vegetable and animal life, and when salt is eaten with the food, this vapour is hurtfully generated within the body, so causing scurvy, or if operating more slowly it causes consumption or decline."

This is medical science *in excelso*, and would excite our risible faculties, were it not for the sad spectacle of a man, who lays claim to a high scientific and professional education, having the right, by virtue of his degree of M.D., to decide on questions of life and death, yet proves himself void of the commonest powers of logic, and ignorant of the elementary facts of science. It is not a book which is written during the scholastic ages, in the fourteenth or fifteenth century, when such ideas and reasoning powers prevailed, but in the year of grace 1851, nine years after a translation of Liebig's *Animal Chemistry* was published in England.

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[1] Dr. Robert Howard, *Salt the Forbidden Fruit*, 4th ed., London, 1851.

It is idle to retort, that the work has met with no acknowledgment, when we find its effect in newspaper paragraphs and its doctrines still cited by men of education, as far as this latter will count for anything.

But Dr. Howard is only one amongst many, who have raised a lance in the crusade against the use of common salt. In *The Hydropathic Review*, "A Professional Work" (New York, 1855, vol. i., p. 636), appears an article on "Salt" by Joel Shew, M.D., from which I will quote one or two paragraphs :—

"Salt then, or the chloride of sodium, is a mineral poison, and in all works of any note on the subject of poisons, it is treated as such. It is found in no form of natural food; is an indigestible article; never goes to nourish any part or portion of the living body, as we have every reason to believe, but always leaves the system as it enters it: *A mineral, indigestible poison.*"

I think we have learnt enough about the office which common salt fulfils in the human body, directly as a food and indirectly as an agent for stimulating and in some instances actually partaking of the functions of the various organs, to prove the unscientific character of the above assertion; but to show upon what ground this is made, let us see what proofs Dr. Joel Shew brings forward.

"Respecting the poisonous effects of salt *when taken in large doses* one or two quotations shall be given. Dr. Taylor of London mentions an instance of common salt having caused death; the case happening in the north of England in the year 1839. A young lady swallowed, it was supposed, about *half a pound* of this substance for the purpose of destroying worms."

"Dr. Christison of Edinburgh, also a celebrated writer on poisons, mentions the case of a man, who had been in the custom of exhibiting various feats of gluttony, and who proposed to sup *a pound of common salt* in a pint of ale: he died within twenty-four hours." But where is the doctor's physiological knowledge?

There is not a single ingredient of the human body, even apparently the most innocent, which in excess and with abuse like the above, can and does not endanger life. We need not point to phosphoric acid or its salt, phosphate of potash, also an absolutely necessary mineral component of the human body, without which it could not exist; but among the organic, the nitrogenous nutriments, we meet compounds which, in excess and with deficient oxygenation, become virulent poisons,[1] far more deadly and effective, than we find among those inorganic substances, which are normal to the animal economy.

When referring to the cause of scurvy Dr. Shew again in a warning spirit, speaks about salt, "when taken in *large quantities*," and he adds, "to cure which" (the scurvy) "it is found indispensably necessary to substitute fresh vegetable food for that which is salt. This, it appears to me," he says, "is one of the strongest of all evidences against the dietetic use of salt."

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[1] Liebig's *Chemistry in its Application to Agriculture and Physiology*, 3rd ed., London, 1843, pp. 363-390.

We have seen that this assumed effect of salt rests, first (erroneously), on the use of *salted* meat and not on the general use of common salt; and secondly, on the absence of fresh vegetables, and in these the potash salts which cause scurvy.

And when relating Lord Somerville's report about the punishment, applied in Holland during the last century, according to which criminals were condemned to live upon saltless bread and plain water, and who died from worms engendered in their own *stomachs*, he says: "Now mark this is an old story" (and by this he probably means that, as such, it ceases to be true), "the facts of which we are by no means sure of".

This is not a commendable way to contest this question. The earliest record, which I have been able to find about this story is in Aitken's *Elements of Physiology*, published in 1838 (p. 159); but there is every probability of the statement being correct, that the prisoners died, not perhaps from worms in their own *stomachs*.

It looks puerile when the learned doctor admonishes us against the use of salt, for the reason that it once occurred, that some specimen of it contained impurities, a combination of iodine with sodium; but he nevertheless admits "that *a small portion of the article, taken even habitually, can cause no very great difference in one's health in a short time*".

In what a false position a teacher can place himself when instructing the perfectly ignorant, is illustrated by an article on "Salt Eating," by Mr. T. R. Allinson, Ex-L.R.C.P.Ed., etc.

I will pick out only the most glaring and positively false statements from this hygienic sermon, to show how the trusting people can be misled :—

"Animals in a natural condition will not usually eat salt, nor will the untutored savage".

Ans. Wild, *i.e.*, undomesticated, herbivorous animals will travel for miles to reach salt, and Mr. Allinson's untutored savages will sell wife and children for this "useless" substance.

"My" (Mr. Allinson's) "objection to salt is that it is a mineral, and therefore should never be used."

Ans. This is an objection which savours of quackery. Not only that mineral substances enter into the constitution of all parts of the organism, and are as such absolutely necessary, but if an animal is fed with food from which all mineral ingredients have been extracted, it—the animal—will die quicker, than when all food is withheld.

"The fact that salt is found in all our tissues and fluids is no argument, for the greater part of it got there after being added to the food."

Ans. Mr. Allinson appears to be a scientific Rip van Winkle, as he does not know, what has been established more than a century ago, that without salt the blood cannot be formed. But he shelters himself behind the words "greater part".

"Salt stimulates the appetite, causing us to overeat."

Ans. Mr. Allinson shows no judgment here. Overeating, as he very correctly states, causes seven-tenths of our ailments ; but he will allow me to suggest it is more the result of drinking with our meals—washing the food down (instead of thoroughly masticating and insalivating it)—which causes overeating.

" In the stomach salt causes acidity and heartburn."

Ans. Just the contrary. Absence of common salt allows the formation of lactic and butyric acids as the result of an abnormal fermentation in amylaceous food, and these acids are the real cause of heartburn. Such a statement should make any physician's conscience burn.

" Salt and water is a common remedy used to make a person vomit."

Ans. Yes. And it will probably astonish the "doctor" that salt and water will also *stop* vomiting and enable food to be retained on the stomach; it all depends on the quantity administered.

But it is useless to quote further from this pseudo-scientific sermon. Mr. Allinson, although a physician who does some good among his readers, has to learn a little more, before he can claim to be a teacher on this subject. His article contains several other erroneous statements, some of them very one-sided, most of which find an answer in various parts of this treatise.

I would not have thought it necessary to notice Mr. Allinson's essay on Salt to the extent I have done, but for the fact, that he has gained the ear of a large circle of readers among the half-educated public, and has otherwise gained a hold upon the people through the spread of hygienic knowledge.

When he, however, asserts that " no disease can arise as a consequence of abstaining from salt," his dogmatism surpasses his want of knowledge on the subject, and his doctrine becomes a real danger to his fellow-men.

He settles the question about the punishment of prisoners in Holland in the last century, already referred to, in a most authoritative manner, by *branding this Dutch story as an unvarnished lie.* This reveals to us the scientific basis of Mr. Allinson's knowledge; and it will cause us to smile when, after this indignant remonstrance, we read:—

"*The moral I want my readers to draw is:—*
Use salt moderately".

As a parallel to the above-stated punishment in Holland, it may be worthy of notice that, up to the middle of the present century, there existed in Sweden an alternative punishment of either death or of an abstinence from common salt of every kind for the period of twenty-eight days. Whoever could pass through this ordeal without succumbing to it, was considered as enjoying a special protection from Providence.[1]

I have been engaged in controversies with several anti-salt-eaters, of which one deserves mention here, as my opponent was a medical man well known in Germany, Dr. Heinrich Lahmann. In an attack on my treatise on *Immunity against Cholera*, he expressed his disapproval of the use of common salt, but in the end his objection resolved itself into a condemnation of an excessive use and of salted meat. To understand Dr. Lahmann's opposition it must be known, that his name is attached to a commercial article called "nutritive salt".

But in no case has any scientific reason, either on physiological or on hygienic grounds, been advanced against even the liberal, much less against the judicious use of common salt.

The whole question turns upon the quantity supplied to our system in small doses during a stated period, and to the answer of this question we will now direct our attention.

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[1] Dr. Glinzer, *Das Salz*, Hamburg, 1887, p. 5.

CHAPTER XXVIII.

HOW MUCH SALT DO WE REQUIRE?

IT would seem to be almost impossible to give an approximately correct reply to this question, as we meet with great discrepancies in the opinions expressed, and also with great difference in the results obtained by physiologists, who have attempted to settle this point by experiment, *viz.*, to decide what quantity is required to make up the loss sustained by the system during a determined period.

When considering the close relation existing between common salt and water, it must at once strike us as of importance, how much liquid a person takes, to enable us to judge from it as to the quantity of salt lost or retained. We may put salt into the soup, which latter is, however, and very properly, not so frequently found on our table as it is in France, and by which Frenchmen receive the greater part of their daily supply of common salt;[1] but the rest of the liquids taken contain no sodium-chloride, except, perhaps, one or two of the mineral waters.

Yet all this water, in leaving the system, deprives the organism of salt, and unless this is replaced by a liberal supply, the common salt is always kept at its minimum proportion of 2·0 to 2·5 per 1000, at the great risk of the blood being destroyed and the body being exposed to various ailments. It is this habit of surcharging the system with liquids, which is the first step to undermine our health, and is the chief cause for the great demand of common salt to protect our organism. The quantity of water which leaves the system and carries salt along with it depends, of course, on the amount imbibed. This may vary from one pint (I have passed days with considerably less in the form of liquid per diem) of the abstemious, up to the 20 bocks or seidel of lager beer swallowed by the Bavarian beer drinker (amounting probably to more than two gallons) in twenty-four hours.

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[1] Lefebvre, *Le Sel*, Paris, 1882, p. 34.

Moleschott[1] cites Wundt's experiments, in which the water, taken in the food and as beverage, amounted to 3400 grams, equal to nearly one gallon per day. At the density in which salt is contained in the blood, this amount of liquid would extract from the system 3½ times 4 or 14 grams of salt; but some common salt would leave the body in combination with organic secretions of the kidneys, and also in the fæces with the bile. This would seem to correspond with the amounts obtained by other experimenters.

Payen[2] estimates the daily consumption at 17 grams; and Milne-Edwards[3] thinks, "que l'on peut admettre pour la consommation annuelle de chaque individu a Paris, les nombres suivants :—

6·5 kilgrm.	pour un homme adulte,
4·5 ,,	pour une femme,
2·5 ,,	pour les enfants et jeunes gens des deux sexes".

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[1] Moleschott, *Physiologie der Nahrungsmittel*, p. 223.

[2] Payen, *Des Substances Alimentaires*, 2nd ed., Paris, 1854, p. 302.

[3] *Le Sel*, p. 35.

This would give a daily amount of 17, 12 and 7 grams respectively.

Barral values the amount at from 6 to 12 grams for an adult, and from 3 to 5 grams for infants; but his estimate rests very probably on his extensive experiments with sheep, and he does not inform us whether these animals were much in the habit of taking tea, beer or table waters with their meals.

German salt statistics report an annual consumption of 7·5 kilograms per head, which is about 21 grams per day; and Muspratt[1] estimates the consumption in England at 20 lb. (about 25 grams per day), and in France at 15 lb. (about 17 grams per day) per head.

The amount which our Admiralty has ordered to be supplied for the use of the sailors in the navy, *viz.*, "in the proportion of 1 oz. per man every four days," *i.e.*, about 7 grams per day, would hence appear insufficient, especially if this amount is to include that generally used by the cook in preparing the food.

To answer the so frequently made assertion that the common, salt naturally contained in the food, is sufficient for our requirements, Moleschott[2] refers to beef as distinguished by its richness in sodium-chloride; yet he points out, assuming the daily quantity of salt required by an adult as only 12 grams, it will necessitate the consumption of 2 kilograms,[3] that is, of 4·4 lb. of meat (a truly carnivorous diet), to supply that quantity of salt to the system if none is added to the beef.

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[1] Muspratt, ii., p. 897.

[2] Moleschott, *Physiologie der Nahrungsmittel*, p. 357.

[3] There appears to be an error here. Beef, as we shall see immediately, contains 3·10 grams of common salt per kilogram; hence to obtain 12 grams it will require nearly 4 kilograms, *i.e.*, 8·8 lb. of beef.

Lehmann, who throughout his *Physiological Chemistry* "shows the importance of sodium-chloride in the metamorphosis of the animal tissues"; who calls attention to "the fact, that it always forms *the greatest part* of the soluble constituents *of the ash* of all animal substances";[1] who reports, that the result of a series of investigations shows *the amount of common salt secreted during* twenty-four *hours to be* 10·46 *grams*, and who admits that "altogether less chlorine" (*i.e.*, chloride of sodium) "is excreted in the urine than is supplied to the system, and that the remainder must be eliminated some other way"[2]—all of which points to the necessity of a liberal supply independent of food—yet declares[3] that: "A glance at the results of the analysis of the ashes of plants is sufficient to show that the ordinary articles of vegetable food are perfectly sufficient to supply the necessary quantity of salt to the animal body". The whole statement is rather contradictory.

We have already noted the proportion of salt contained in beef; let us now inquire into the quantity of it which we receive in other kinds of alimentary substances, to ascertain, how far such an assertion about the sufficient supply of salt is justified.

The following two tables are copied from Prof. Moleschott's *Physiology of Food*,[4] the two classes of nutriments being kept distinct:—

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[1] Lehmann, vol. i., p. 430.

[2] *Ibid.* (German 2nd ed.), vol. ii., p. 347.

[3] *Ibid.* (English ed.), vol. i., p. 436.

[4] Moleschott, *Physiologie der Nahrungsmittel*, Table CXXIX. and Table CCXLV.

ANIMAL FOOD.

1000 parts contain	NaCl
Pork	0·12
Sheep's liver	0·14
Pig's liver	0·14
Carp	0·26
Veal	0·82
Yolk of egg	1·08
White of egg	1·09
Beef	3·10
Human blood mean	4·50

VEGETABLE FOOD.

1000 parts contain	NaCl
Rice	0·13
Oats	0·24
Asparagus	0·48
Cauliflower	0·79
Turnips	1·44
Peas	1·63
Rye	1·83
Wheat	1·91
Barley	1·95
Lentils	2·21
Yellow turnips	2·56
Spinach	6·05

These tables will enable us, by applying Prof. Moleschott's illustration, which he used in the case of beef, to estimate the enormous quantity of food which we should have to consume in order to furnish the amount of common salt required for our system during twenty-four hours, if we did not add it to our food or in some other way supply it to our organism, unless we imitate the Esquimaux and Samojedes and drink blood.

But not all physiologists believe in this natural sufficiency of salt in the food. On the side of Moleschott we have to range Milne-Edwards, who declares that: "Pour l'homme, la proportion de chlorure de sodium, qui existe dans les aliments, tels que la Nature nous les fournit, est en général insuffisante, et il est très utile d'y ajouter une petite quantité de cette matière saline". And he considers that, amongst other offices, it is useful "pour modifier l'action par l'eau qui peut se trouver introduite en quantité considérable dans le torrent de la circulation".[1]

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[1] H. Milne-Edwards, *Leçon sur la Physiologie*, Tome Huitième, Paris, 1863, p. 190 *et seq.*

Dr. Pavy, whose *Treatise on Food and Dietetics* enjoys a prominent position in English medical literature,[1] just mentions the name of common salt; he refers, under the heading of "Inorganic Alimentary Principles," to the "Chlorides and Soda Salts in the Plasma"; and under "Condiments," he says: "One, *viz.*, salt, is simply of a saline nature. It is the most universally employed of all" (condiments). Such slight, such almost contemptuous indifference, shown to the (certainly in quantity and general utility) most important inorganic ingredient, by an authority on the subject of nutrition, etc., must naturally induce a disregard about the necessity of supplying common salt to the system. And such slight becomes most surprising when it is considered, that the above work was published in 1874—twenty and more years after the direct and indirect influence of common salt on the digestive process had been fully established.

Dr. Edward Smith, in his *Practical Dietary*,[2] mentions common salt under condiments, and warns against an *excess* of it in the blood, as it impedes vital changes and leads to ill-health (? ?). The doctor evidently does not know that the blood cannot store salt in excess, and he fails to inform us what "ill-health" is produced. But we must smile, when he also recommends his readers "a daily supply for an adult of ¼ to ½ oz." (equal to from 7 to 14 grams).

Among the opponents to a liberal use of salt I dare not omit to mention Klein and Verson (Dr. E. Klein is at present Professor of Physiology at St. Bartholomew

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[1] Dr. F. W. Pavy, *A Treatise on Food and Dietetics*, London, 1874 pp. 128, 380.

[2] Dr. Edward Smith, *Practical Dietary*, London, 1865, pp. 117-118.

Hospital in London), who concluded from the effects they experienced, when abstaining from salt, that the addition of this latter to our food was merely a luxurious habit. Their experiments and the deductions they drew from them, have been analysed by Prof. J. Forster,[1] who proved that the investigators were not justified in their conclusions.

I will close this part of our inquiry with the record of some experiments, made by Kaupp and cited by Prof. Voit.[2]

Kaupp added each day during his experiments a measured quantity of common salt to his food, noted the total amount and then compared this latter with the amount secreted by the kidneys; thus he obtained the following result:—

Total Quantity of Salt Taken.	Quantity Eliminated by the Kidneys.	Percentage of Total Quantity Eliminated.
33·6	27·302	76
28·7	24·057	79
23·9	17·633	72
19·0	17·054	89
—14·2—	—13·573—	—96—
9·3	10·083	106
1·5	3·773	246

Prof. Voit accompanies this table by the following remarks: "The smaller hence the supply of common salt, the relatively greater is the loss, until at last this latter exceeds the former. Kaupp then asks: 'What becomes of the missing salt?' and he is the first to give the correct reply, *viz.*, 'the body can store a certain amount of it'. In fact, during a diminished supply, the loss is for some days even greater than the supply; which loss amounted in one series of the experiments in twenty-four days to 41 grams, and when the salt is taken again in larger quantities, it is retained, and less is eliminated than is taken."

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[1] *Z. f. Biologie*, vol. ix., p. 307.

[2] Prof. Dr. Carl Voit, *Untersuchungen über den Einfluss des Kochsalzes auf den Stoff-wechsel*, München, 1860, pp. 37-38.

The above table is to my mind most instructive.

When comparing the various figures, and balancing the gain and loss of the system in the amount of common salt, I feel inclined to consider, that that quantity in the daily supply, which causes a fair balance between the supply and the loss, would be the normal amount daily required by our organism; and that quantity appears to be between 12 and 15 grams (about half an ounce) per day. This would also appear to be the average mean among the various quantities suggested by Payen and Milne-Edwards, and seems to be confirmed by the statistics of the various nations.

But whatever it is, whether 12, 15, 17, or as Moleschott and Kaupp suggest, 30 grams, it entirely depends on the quantity of water, in one form or another, which we imbibe; and if we do consume a little more salt—in solution—it passes through the system without doing any harm. On the contrary, the excretion of the salt and the water cleanses the system, by freeing it of its own poison, urea and uric acid; and thus it protects our health and prevents disease.

CHAPTER XXIX.

HOW TO TAKE THE SALT.

It is a generally prevailing idea that, when the question of supplying salt to our organism is raised, it means eating salt with food; and although the visits to the various mineral baths and watering-places would direct the attention to the fact, that common salt can be furnished to our system in solution, and that this can be done at home equally effectively, such a conclusion never enters the ordinary mind. But this is owing to the belief, no doubt, that the ingredients of the mineral springs—although chemically the same as the mineral substances at home—must have some special virtues, otherwise the "doctor" would not have sent the sufferer on the continent. We will not inquire into the true reason for the latter, but will direct our attention to the best, most pleasant and most beneficial way of supplying sodium-chloride to our system; and in relation to this question I have already pointed out in several places the answer, that it is *as a solution of salt and water.*

There is a very valid reason, why it is not desirable to take all the salt, required by our organism, only with food. We have seen on a former occasion, when dealing with the subject of digestion, that the normal gastric secretion contains 0·15 per cent. of common salt; this is a very low proportion. If we add to this no more than is necessary to make the food tasty, the gastric digestion is not much interfered with ; but an increase of this proportion to 0·5 or 0·6 per cent. will prolong the time of solution from three to tenfold ;[1] and an increase to 1·5 or 2 per cent. seems to arrest digestion altogether.

This effect of common salt on the digestion might be lessened, and perhaps altogether prevented, if sufficient water were taken with the food—a practice which is so frequently recommended ; but we have learnt already, that the potations during our meals are certainly not advisable.

In relation to this undoubtedly important question of drinking with our food, there is a statement in Geo. H. Lewes' *Physiology of Common Life*, which deserves a word of explanation, coming from so credible an authority. When directing attention to the evils of "overloading the stomach with more food than it can move," he makes the following remark : "There is another fact mentioned by Lehmann, which is fertile in suggestion, namely, that the addition of water, so far from weakening, increases the power of the gastric juice".[2]

This assertion rests, I think, on a complete misunderstanding of Lehmann's exposition of the facts. On referring to the English translation, as also to the second German edition, I find the following statement : "The following facts are worthy of notice in reference to the digestive power of the gastric juice". These facts are the results of sundry processes and chemical agents, which either suspend or impede the action of solving the food experimented on—all referring to *experiments made in the laboratory outside the human body*—and in relation to these Lehmann says : "The addition of water

[1] Prof. Maly, Hermann, v.b, p. 88.

[2] G. H. Lewes, i., p. 210.

to a gastric juice, *which has been already saturated with peptones*, enables it to digest an *additional* quantity of protein substances".

Let me call back into your recollection the fact, that the most powerful digestive action of the gastric juice depends upon a definite density of the hydrochloric acid, that the human stomach secretion has on the average already a tendency to a low acidity (see p. 111), and that hence a further dilution would be detrimental. Besides, how can we possibly expect an alderman or a gourmand to apply the same test to the contents of his stomach, as we can in a laboratory, to know whether all his gastric juice is already saturated with peptones, and that, as he wants to eat still more, he must drink some water, the last of all beverages, an alderman or a bon-vivant would take?

Does not this, as already mentioned, lead to gluttony? No. Let us be satisfied with the normal quantity of gastric juice, as secreted by a healthy stomach, and so frame our habits and adjust our desires, that we bring them in accord with the natural normal functions of our organism.

We shall be encouraged in this attempt if we notice what Bidder and Schmidt have to say on this question. Speaking about the necessity of a proper dilution of the food in the process of digestion, to facilitate its absorption into the circulation, they remark:[1] "The quantity of the secreted gastric juice must hence be greater, the less liquid is taken into the stomach. Dogs, with a meat diet, drink little or nothing; and it is highly probable, that other animals, that have to resort to taking liquids,[2] do not secrete gastric juice in the quantity, as we find it in dogs."

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[1] Bidder und Schmidt, p. 86.

[2] *Die an eine reichlichere Aufnahme von Getränken angewiesen sind.*

In other words, drinking with our meals lessens the secretion of the normal quantity of gastric juice, and is thus the commencement of indigestion with the various ailments following in its train.

Prof. Bunge's advice on this point deserves notice. He says:[1] "I must not omit to call attention to the fact how irrational it is to commence a dinner with soup, or to drink during meals, since the gastric juice becomes thereby too diluted, and loses all its *disinfecting* properties. It is a well-attested and important rule not to drink, until a few hours after a meal, and then only when thirst demands it."

I must admit, from observations and from the answers which I have received in reply to my advice about the abstinence from liquids during meals, that it appears no easy task to change ingrained bad habits, which demands from us a little—perhaps in many cases insuperable—self-control to succeed; but it can and should be done gradually; we can wean ourselves imperceptibly of pernicious—and as slowly accustom ourselves to health-producing—habits. Human nature is wonderfully elastic; but it breaks down under any sudden change; it requires time for adaptation:

Natura non facit saltus.

I trust I shall be pardoned for deviating from the main subject to a side issue. The consumption of salt and the imbibing of liquids stand in so close a relation to each other, that I could not possibly leave this question of drinking with our food unnoticed, without the principal subject appearing incomplete.

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[1] Bunge, p. 156.

It would hence appear that—teleologically considered—we should add but little salt to our food ; nor should we drink whilst eating, but allow the food, after a thorough mastication and insalivation, to be dissolved in the gastric juice only.

Our question has narrowed itself now, first, to the best time when to take the salt solution ; and next, to determine the strength of the latter.

My own experience suggests the early morning, before breakfast, in fact soon after rising, and before leaving the bedroom, as the most suitable time ; and, should a second or third dose during the day be desirable, it might be taken an hour before a meal, or before retiring to rest.

Taking the common salt in this way—independent of food, it offers the advantage of being readily absorbed into the circulation, and of thus acting more effectively, than when introduced into the system in company with food, which latter, to some extent, limits the free action of the salt.

In the ordinary state of health, the one dose during the day—besides what is added to our food at the table—will be found sufficient ; but in cases of indisposition, or a general constitutional ailing, or in times of epidemics (about which more anon) when no plain water or any unboiled liquid should be taken, the morning dose might be repeated, as often as thirst demands it.

With regard to the strength of the solution, I must give the general advice : MIX IT SO, THAT IT TASTES PLEASANT. The most suitable proportion is about $\frac{3}{4}$ to 1 per cent., that is, 1 gram of salt to 100 or 150 grams of water, and this mixture can be obtained approximately by dissolving as much common salt as will lie easily heaped up on a shilling in half a tumblerful of water, estimating the tumbler as equal to half a pint.

For those, whose system has been insufficiently supplied with salt, even the above mixture may appear too strong, in which case it is advisable to add more water, until after a few mornings the above-named strength will not be objected to. The salt imparts to the water a peculiar softness, and plain water tastes insipid and unpleasant after it.

There is mostly a tendency of making the solution too strong, which may cause a temporary aversion to it ; and in cases, in which the stomach is out of order, it has occasioned vomiting. I have always advised to repeat the dose less strong ; and invariably the second ingestion has been kept on the stomach. This latter organ has been in such cases in a very poor and perhaps enfeebled condition, with greatly disturbed digestive powers ; but after a few mornings the tasteless solution could be taken without any trouble, and a better appetite for breakfast followed. In fact, in many cases have I been assured, especially by ladies, that they could not enjoy their breakfast, unless they had had their salt and water.

The solution is best prepared by placing the dry finely-powdered salt first into the glass, and then pouring the water upon it, whereby the salt is at once stirred up and quickly dissolved. As the mineral has a great affinity for moisture, it should be kept in a glass-stoppered bottle ; such a bottle, as shown in the annexed sketch, can be purchased for a few pence from any chemist. Each is provided with a bone spoon on which, after a little experience, the exact quantity of salt for a whole or half a tumberful of solution can readily be measured off.

To assist the memory it is advisable to keep such a bottle in each bedroom on the washstand near the water-bottle, as also in the dining-room on the table or the sideboard wherever drinking water makes its appearance, especially, as already stated, during the existence or the threatening of epidemics, *and still more so in the tropics.*

I cannot repeat it too often, the solution should be so strong that it tastes pleasant. It should constantly be borne in mind, that it is not the single dose which, magic-like, acts so beneficially on the system, but the repeated daily supply. Such small quantities as here mentioned are, however, sufficient only for maintaining the required quantity in the body, when this latter possesses already its full proportion of salt. For cases of constitutional disorder, which require the administration of common salt in larger quantities, with perhaps the addition of any other salt, it assumes less the character of hygiene and prophylaxis, and enters on the domain of medicine, to which we may revert later on.

As much salt as will
lie easily heaped on a
shilling in half a
tumblerful of water

(Note) Begin with smalle
quantity — say, a 'sixpenc
ful'.

CHAPTER XXX.

SEA-WATER AND NATURAL OR ARTIFICIAL MINERAL WATERS.

AMONGST the many remarks, which my advice has occasioned, has been not unfrequently the suggestive question: "Will not sea-water do the same service?" It may, therefore, not be out of place here to answer that interrogation.

Sea-water contains, as a mean, according to Muspratt:—[1]

Water	96·470
Chloride of sodium	2·700
Chloride of potassium	0·070
Chloride of magnesium	0·360
Sulphate of magnesium	0·230
Sulphate of lime	0·140
Carbonate of lime	0·003
Bromide of magnesium	0·002
Iodides, etc.	0·025
	100·000

What deserves our special notice is the proportion, in which common salt is found in sea-water, in relation to all the other salts:—

Chloride of sodium	2·700
Other salts	0·830
And of these the two magnesium salts	0·590

It is chiefly owing to these latter, that sea-water possesses such a nauseous taste, and, as we shall find, that its hygienic employment is so limited.

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[1] Muspratt, ii., p. 899.

The amount of common salt in a litre (*i.e.*, 1000 grams) of sea-water is therefore 27 grams; that is, about from 5 to 5½ times the proportion, in which it is found in the normal blood. Sea-water is hence far too strong to serve for the purpose of supplying common salt to the system by way of the digestive organs; but its use in another way we shall revert to farther on. However, not only its high salinity prohibits its employment as a beverage, but also, if not chiefly, the admixture of other salts—especially, as already mentioned, sulphate of magnesium (Epsom salt).

Some years ago the question of employing sea-water in the manufacture of bread was discussed at the Academy of Science in Paris, and the opinion prevailed, that the presence of the magnesium salts formed the great objection, as it gave a very unpleasant taste to the bread. The question naturally arises: Why employ sea-water when the main object is, to embody common salt with the bread, when this salt is so cheap; when it can be supplied so easily inland, whither sea-water would have to be transported in larger bulk; and when lastly we can by the solution of the simple salt obtain exactly the most suitable mixture we require?

And to a very great extent this same remark applies, when the natural mineral waters come in question. But in relation to this we had better take the advice, and listen to the experience of Dr. Beneke, as offered to us in his *Balneologische Briefe*. When speaking of the extent in the application of mineral waters, he raises the question, whether nature has not sometimes mixed together ingredients, which for medicinal purposes would have better been kept apart, and which in one direction are perhaps as beneficial, as they act in the other harmful.

He singles out chloride of calcium, of which Dr. Joseph Kidd made mention, as one of the factors for curing heart disease in Nauheim; and (on page 134) he advises prudence in the use of the Nauheim waters, owing to the presence of the chloride of calcium in considerable quantity.

"The 0·389 gram of sulphate of lime, which is contained in one litre of the Kissingen Ragoczy, does not make the latter commendable with all its other advantages; and the well-known bitter waters of Friedrichshall, Püllna, etc., would certainly be more commendable were they without the 0·3 to 1·3 gram of gypsum per litre. It is also a noteworthy fact that the famous Carlsbad water contains, with the chloride of sodium and the Glauber salt (both of which act so beneficially on the liver), carbonate of soda, which has quite the contrary effect.

"The Carlsbad Mühlbrunnen contains in 1000 parts 2·3 Glauber salt, 1·024 common salt, and 2 parts of carbonate of soda.

"This vexation and contrariety in the composition of many natural mineral waters demands our earnest consideration, and I think I am justified in saying, that in many cases our therapeutic objects are surer and easier achieved, by such a modification of the waters, as the individual case may demand, than to advise the drinking of these waters as offered to us by nature."

Dr. Beneke then suggests many modifications in the shape of exclusions of certain ingredients from various waters; and for effecting improvements in a sluggish metamorphosis of matter in the system generally, in fact, for raising the life and various functions of the organism, he recommends "as the simplest means, a simple solution of common salt, ½ to 1 per cent., taken either warm or cold according to individual circumstances, of which from 300 to 600 ccm. should be taken every morning on an empty stomach.

" The effect of drinking such a solution, on the increase in the metamorphosis (the change) of albuminoid substances, is inevitable ; and it can approximately be estimated that 5 grams of common salt dissolved in 600 ccm. of water, will increase the change in nitrogenous components of the body by $\frac{1}{6}$th during the twenty-fours. *Nature does not offer us such a simple solution of common salt anywhere.*

" We hence employ the simple artificial solution mostly, in such cases as 'rheumatism of the joints' (including the concomitant heart disease), 'gout, scrofula, hyperæmia of the liver, and catarrh of the respiratory organs'."

With this simple remedy he advises the simultaneous enjoyment of sea or mountain air ; or combine with it other hygienic or climatic means according to the nature and character of the ailment ; and he adds : " We must not forget the local effect of the simple common salt solution on the mucous membrane of the stomach and of its glands. The gentle irritation effected by this solution increases the secretion of gastric juice, and the masses of viscous mucus, which probably covers the lining membrane in chronic gastritis, are thereby removed.

" The solution of common salt thus administered to the patient, must, however, not be increased either in quantity or in concentration to such a degree as to cause a purging effect."[1]

Were it our object to learn more of the absolute and the comparative effect of the various ingredients of different mineral waters, such as, for instance, the evil effect of the "sulphur waters" in hastening the destruction of the blood corpuscles (p. 158), we could with advantage dive deeper into his excellent treatise; but our object is to ascertain how far Dr. Beneke warns us against the indiscriminate use of the natural mineral waters, and to learn his advice about the daily consumption of common salt, and the manner of taking it. And here he recommends, as already mentioned, that with their salt in their trunks, patients should seek the sea-shore and the mountain air, to brace their system up by enjoying these gifts of nature. And to make sure of the result, he impresses upon his readers, "to employ greatly diluted solutions, and make a continued use of it for a long time, which will unfailingly achieve the object".

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[1] Beneke, p. 134.

We have here all the necessary information required to guide us in an estimate of the comparative advantages of drinking the mineral waters on the continent, or taking our daily dose of sodium-chloride at home, in relation to general constitutional ailments; and although our object here cannot be to give any advice to sufferers, we are justified in saying, that for those, who desire to maintain their health and protect themselves against disease, we have discovered sufficient facts to guide us in the application of nature's simple remedy, common salt.

CHAPTER XXXI.

SEA-BATHING.

WE have already seen that sea-water is not only too concentrated as a mere saline solution, but also that it contains a considerable amount of other salts of a nauseous character, which make it unfit and most unsuitable for being used as a beverage to supply common salt to our organism.

Sea-water can, however, serve us in another way for the supply of salt to the system; namely, through the skin in the bath.

Before dealing, however, more fully with this question, I cannot resist the temptation of referring to a suggestive view, advanced by Prof. Bunge in relation to man's descent, and the influence this can have on his constitution and his habits.

Any intelligent observer with a reflecting mind, when endeavouring to penetrate the secrets of nature will, like Thales, have his thoughts directed to the influence of water as one of the factors, to account for organic life on our globe; and we cannot be surprised when we meet already among the Greeks with the dictum: "All life had its origin in the sea"—which great thought, as Prof. Dodel says,[1] recurs throughout the history of the human intellect. And the ancient Greeks, in word and in picture, glorified the belief that Aphrodite or Venus—the goddess of love—arose into life from the foam of the sea-waves.

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[1] Prof. Dr. A. Dodel, *Aus Leben und Wissenschaft*, 1st Theil, p. 18.

Of modern writers we must mention Erasmus Darwin, who also expresses the view, that life had its origin in the sea, in his poem "The Temple of Nature".[1]

More distinctly do we find it enunciated in Prof. Oken's *Physio-philosophy*.[2] This savant states in the chapter on "Organogeny":—

"901. The primary mucus, out of which everything organic has been created, is the sea mucus."

"912. The first organic forms, whether plants or animals, emerged from the shallow parts of the sea."

"913. Man also is a child of the warm and shallow parts of the sea in the neighbourhood of the land."

Prof. Bunge admits, that he hesitates to advance his ideas (which are based, as we shall see, on the principle of the biological, or more correctly perhaps on the evolutionary descent of man), as the facts in its favour are still too few and incomplete; but he declares, he cannot conclude his observations about common salt in the human body, without giving expression to his views.

He says:[3] "I am convinced, that the remarkably great amount of common salt in the vertebrata, and our demand for an addition of common salt to our food, can only be satisfactorily explained by the science of man's descent".

He then refers to the relative distribution of the two alkalies, and to Liebig's discovery "that even in the blood of the herbivorous animals, which take almost solely potash salts in their food, there are in every four parts of alkaline carbonates in the blood serum at least *three parts* of carbonate of *sodium*" (derived from common salt) "and only *one part* of carbonate of *potash*".[1]

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[1] I am not able to give the exact quotation or the page of his works, though I have no doubt about my statement being correct.

[2] Prof. Dr. Lorenz Oken, *Elements of Physio-philosophy*, London, 1847.

[3] Bunge, p. 119.

"How can we explain this singular phenomenon except we remember, that the first vertebrate animals on our globe were all inhabitants of the sea?" And "is not the large amount of common salt in the animals of the continents another proof for the genealogical connection, which these morphological facts force us to accept?"

"In fact, has not every human being, in his individual development, passed through that embryonic state in which he possessed the chorda dorsalis and the gill-fissures of his ancestors, inhabitants of the sea? Why should the high proportion of common salt in our organism not also be an inheritance from ancient times?

"If this view is correct, it will follow, that vertebrate animals in their individual development, are richer in common salt the younger they are. And this is a fact. The vertebrate embryo is richer in salt than the newly-born animal, and the latter loses chlorine and sodium with its further development."

Prof. Bunge then refers to other phenomena bearing upon his suggestion. "The part of our body richest in common salt is cartilage, and it is also the oldest tissue, Histologically it is perfectly identical with the tissue which forms, even at the present day, the skeleton of the selachii" (the oldest species of sea-fish of the shark type).

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[1] Lehmann, iii., p. 242.

"Man's skeleton is also originally" (embryonically) "of a cartilaginous nature.

"All these are facts, which can find an unconstrained explanation only in the assumption, that the vertebrate animals of the continents had their origin in the sea, and are still endeavouring to adapt themselves gradually to an environment, which is poor in common salt."[1]

Speaking about the simplest organic matter, as first evidence of life, Prof. Ranke remarks: "We meet with the smallest organisms by *myriads in the sea* (in insignificant numbers in fresh water), which according to their behaviour we must look upon as animal beings". And in another part of his book, he makes the following pointed remark: "In the blood *man carries the sea*, so to speak, *in his body about with him*, which bathes and nourishes all the cells. *Not a single living cell* of the total organism *can exist even for the shortest moment without the regular interchange with this vital fluid,*" *this salt sea.*[2]

It need scarcely be questioned, that most biologists have entertained the idea, that organic life on our globe found its most favourable conditions for development on the shores of the sea, where land and water meet. The ethnological consideration of the question seems to confirm this, since the most energetic and, at the same time, the finest specimens of the human race are found on land, situated near the sea or surrounded by the sea.

If we yield to a poetical vein, we may look upon the attraction, which the sea has for most human beings, as an unconscious longing for our birthplace; and we can well understand the feeling of wonder and adoration, with which the sea—the glorious sea—is greeted, when approached for the first time; or the joy with which young and old return to the sea-shore—to revive the animal powers, to restore the jaded spirits and to cleanse the system from the dragglings of an overtaxed social life, by *a dip in the sea.*

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[1] Bunge, p. 121.

[2] Prof. J. Ranke, *Das Blut*, München, 1878.

"The inmates of every seaside infirmary can tell a yet happy tale of the beneficence of salt breezes. They speak of lingering diseases fortunately ended; of long convalescence speedily consummated by cure. Many a life, which seemed gradually ebbing away in the atmosphere of a crowded city hospital, have these briny vapours called back and fortified and cheered with long years of health. Salt plays here the part of a good fairy; it makes of this infirmary a healing heaven for the bodily sick."[1]

"There does not exist, in the whole repertory of medicine, an agent with greater restorative powers than marine medication. By its vivifying properties, by the saline and aromatic principles which it contains, the sea is a beneficial mother"—says Dr. Brochard.[2]

And how many cases of insidious diseases, which seemed to be deeply rooted in the constitution and resisted all medical treatment, have not been cured by sea-bathing. I have seen it reported, that the natives on the west coast of Africa cure small-pox by a repeated and prolonged immersion of the patient in sea-water; and the increasing employment of the brine bath at Droitwich is, no doubt, owing to the successful treatment of a suitable class of diseases.

A great number of experiments have been undertaken to investigate the question, whether or not the skin absorbs water in the bath; but all have failed more or less through the impossibility or the difficulty of weighing the body or the bath water with any approximate exactitude and through the interference of concomitant circumstances. On a proper consideration of this question, it would appear, that the absorption of either water or salt depends entirely on the saline condition of the immersed body and of the bath water, and is determined by the laws of endosmosis.

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[1] Muspratt, ii., p. 906.

[2] Dr. Broçhard, *Sea-Bathing and Sea-Air*, Pref., pp. 12 and 18,

That the skin has pores for water to pass through it is evidenced by perspiration. If now we immerse the body in a warm fresh-water bath, the temperature will tend to open the pores and enlarge the blood-vessels of the skin. The perspiration contains more or less common salt, according to the proportion existing in the blood; and when once this salted perspiration comes in contact—in the interstices of the skin—with the fresh water of the bath, an interchange takes place; water will be absorbed by the skin, and salt will be given off to the bath water—provided, of course, that the proportion of salt in the blood is above the minimum. However slight this action may be, it always is productive of a detrimental condition by making the blood watery and depriving it of salt. When the latter is present in or near the maximum proportion, no very great evil will result; but if the salt is at or near the minimum density, the bath will have a weakening effect on the system, making it liable to "catch cold"—a result so frequently experienced after a warm fresh-water bath.

Let us now inquire into the conditions of a warm sea- or salt-water bath. In this case we have a concentration of salt of—assuming an average—4 per 1000 in the blood-vessels of the skin, and of 27 per 1000 in the sea-water, *i.e.*, the proportion of salt to water is about seven times greater outside, to what it is inside the body. The interchange between the two fluids will now be the reverse; salt will enter the blood, and water will leave the body. In this case the warm salt-water bath acts like the Turkish hot-air bath; it abstracts water from the system, but with this incalculable advantage, that the blood is furnished with the most necessary ingredient required for its existence and for its disease-resisting power; the body will gain in specific gravity (the benefit of which we have learnt from Dr. Jaeger) and will be hardened against colds and influenza.

We can understand now, that there is some foundation in the popular belief, that we do not catch cold from an accidental immersion in sea-water.

Let us furthermore remember, that we cannot surcharge our blood with salt above a certain proportion; that whatever amount of salt over that maximum we absorb into our body, is again eliminated by the kidneys; that by means of this secretion the blood, and with it the whole organism, is relieved of its effete, used-up, poisonous matter; and hence we cannot employ a better means for supplying salt to our system than by a sea- or salt-water bath.

It cannot be difficult to comprehend, how such a procedure can cleanse the body by expelling the morbid substances, and thus cure constitutional disorders.

There is, however, nothing new under the sun. "The ancient inhabitants of the shores of the Mediterranean soon discovered the advantages, which the sea offered as a bath, and that the sea-water possessed the excellent powers of dissolving and washing away the dirt of the epidermis, and thus to purify and give health and strength to the skin. And when it was found that salt, when added to fresh water, possessed the same cleansing properties, it became evident that this property belonged to the salt itself; which latter thus gained in popular estimation.

"Salt was, among the Roman ladies of a later period, admitted to their toilet table as a means of beautification;[1] whilst the Greeks used for the washing and preparation of their sacrifices: sea-water, or, for want of it, salted water."[2]

We have now very good reasons for giving the advice, that a warm bath should always contain salt in a concentration, at least equalling that of the blood, *viz.*, ½ per cent., that is, ½ lb. of salt to each 10 gallons of water. But to be beneficial in the sense as above indicated, it should have a concentration approaching that of sea-water, 1½ to 2, or better still, 2½ lb. of salt to each 10 gallons of water (which is the density of sea-water).

I cannot conclude this part of our subject without expressing the hope, that those excellent hygienic establishments, the Turkish hot-air baths, may give us the advantage of a salt-water immersion, which would act so beneficially on the whole organism, when the skin is in the most favourable condition for absorbing the salt into the body.

With regard to salt-water baths for the general public, I shall revert to this later on, under the heading "What should be done".

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[1] Ovid, *Medicam*, faciei 94 (Schleiden, p. 84).

[2] Homer, *Ilias*, ix., 214; *Odyssey*, ii., 261-2 (Schleiden, p. 85).

CHAPTER XXXII.

DISEASE.

CLAUDIUS GALENUS (short, Galen)—a Roman physician of the second century A.D.—prefixes to his *Methodus Medendi* the following words:[1] "The *magnitude of a disease* is in proportion to *its deviation from the healthy state;* and the extent of this deviation can be ascertained by him only, *who is perfectly acquainted with the healthy state*".

We must read between the lines to understand the large amount of information, which is conveyed in this quotation.

First let us notice that, to be able to understand a disease we must be acquainted with the physiology of the human body in all its parts, when in a healthy condition.

You may call this a platitude, and smile; and yet in the year of grace 1897, at the meeting of the British Association, Prof. Forster declared:[2] "That physiology is and must always be the basis of the healing art is a truism; but if a plebiscite—limited to instructed, one might almost say, scientific men—were taken at the present moment, it would probably enough be found, that the most prevalent conception of physiology is, that it is something, which is in some way an appendage to the art of medicine ".

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[1] Blumenbach's *Elements of Physiology*, 4th ed., London, 1828, Introduction, p. xiv.

[2] Prof. Forster, Presidential Address, British Association, Toronto, *Nature*, 4th Nov., 1897, p. 20.

And a few years ago—1700 years after Galen—we find Prof. Jacob Moleschott,[1] in his introductory physiological discourse at the Turin University, make an earnest appeal to the disciples of the healing art, to accept the teachings of physiology as the basis of medicine. " What in the world," he exclaims, " can we learn from any symptom unless we understand the signs in which it *deviates* from the healthy physiological state, etc. ? "

These opinions could be multiplied if space permitted. They show the struggle, carried on now for nearly two centuries, to give to the healing art a true scientific basis ; and this attempt, re-echoing through many lectures and even in some of the opening addresses at the hospitals, is a definite proof that such scientific basis does not exist—the contrary assertion of medical periodicals and professional statements notwithstanding.

The next thing we can learn from Galen's quotation is a true and simple definition of disease : *a deviation from the healthy normal state.* If you reflect upon this definition whilst remembering that nature, does not work by leaps and bounds, but more or less by slow changes, you will understand that most, except the infectious diseases, develop gradually and that they are always the consequence of an unhygienic treatment of the body.

May this be the result of unavoidable circumstances, as is the case with the unfortunate beings who, in dingy factories or workshops or in unwholesome dwellings unfit for human beings, pass their days and years until death relieves them of a toilsome existence; or may it be caused by indulgent, luxurious habits; or be the consequence of conceited ignorance—in each case the diseases, resulting from such maltreatment of our body, are strictly and truly preventable diseases, which justifies Sir John Lubbock in declaring, in his excellent article on "Health," "It is very much our own fault that we are ill".

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[1] Moleschott, *Natur. und Heilkunde*, Giessen, 1865, p. 21.

This seems a hard word, but it is true. And I often express this when I say, I want no one's pity when I am ill, it is my own fault; and when asked for pity for other sufferers (if not ill through poverty), I can but reply, that I pity them for not being better informed.

Why I have dwelt so long and to such an extent on this question, is the desire, to impress upon you, that disease does not come upon us unawares, and enters our body like a "diabolus minor," who requires a "specific—an anti-diabolus" to drive him out again; that when we have maltreated our system by bad habits, by indulgences, by a yielding to temptations, extending over months and years, it is idle and barbarous to expect, that a "doctor" shall give us a draught of some mysterious substance, which has the still more mysterious power, to expel this little demon and restore our diseased and altered body, as with the magic wand, to a normal healthy state. Yet this is the expectation of the ordinary man and woman, who even lay claim to some kind of education, and who truly may be pitied for "not knowing better".

Let me borrow from the writings of one of the most famous authorities on physiological and medical subjects, Prof. R. Virchow, who, as original thinker, or as teacher, or as physician, stands first and foremost. He says: [1] "*Disease is a process of life.* A lifeless, a dead body cannot become diseased. We call those processes of life diseased which *deviate* from the regular forms of typical life and which have in them a certain amount of danger. For disease tends towards death, may this be local or general, and thus undermines healthy life. Every diseased process consists in a disturbance of either the nutrition, or of the formation of new tissue, or of the functions of the various organs. In every case the cure is effected through the re-establishment of harmony of the organism. The curative powers reside in the living part of the body. Every external *interference is or should be but a means to restore the internal organs of the body to a regular normal activity.*"

You will ask very naturally, what has this to do with common salt? It is this. My object in expounding so elaborately the true nature and character of "disease" is: to impress on your mind the fact that any means, any drug if you will, any procedure, can only have the object and only serve to assist in restoring "the various organs of the body to a regular normal activity: that a drug does not act through some mysterious power, and that, when the daily consumption of common salt is advised, you must not think it is a specific, which is indicated in a kind of ready reckoner against a certain disease or class of diseases.

When your mind is freed from this remnant of savage ages, you will be better able to comprehend what we may learn of the influence which common salt exercises, directly and indirectly, on the regular normal activity of the various internal organs, *i.e.*, the harmony of the body, and thus how it can assist in maintaining health and preventing disease.

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[1] Virchow, *Die Heilkräfte des Organismus*, Wissenschaftliche Vorträge, Heft 221, Berlin, 1875, pp. 27-31.

CHAPTER XXXIII.

SALT AND THE PREVENTION OF DISEASE.

WE have in our inquiry so far met already with such overwhelming evidence of the beneficial effect, which common salt has on our organism, that it will scarcely need any further appeal to your judgment for the practical adoption of the advice of supplying this mineral to your system, as an absolutely necessary food.

But the relation of sodium-chloride to some forms of disorders of our body, and its signal influence on their prevention, are of so much importance, that I invite you to accompany me still further in the pursuit of our object; as I am convinced that the result will justify my anticipation of an increased interest and of a profounder veneration for this grand gift of nature.

The diseases to which our organism is liable may be classed under two heads :—

1st, those which arise from a violation of the physiological laws of health, and which are mostly the outcome of our own ignorance, or of the mismanagement of our system;

2nd, those which are the result of an organic poison, which has found its way into our body.

It need scarcely be mentioned, that surgical diseases lie outside the scope of our inquiry; we have to do with diseases from internal causes.

My object will be to consider only a few—and that the most common, and the most familiar maladies ; and of these we will inquire first into the commonest, "*a cold*".

"*Merely a cold.*" Yes ; but how many morbid symptoms and even mortal affections follow at times in its train! And the very term "merely" indicates a disregard for a "cold" as an affliction, which is easily overcome, although there are few men wise and learned enough to know how to cure it. We will not lay claim to this knowledge, but will endeavour to learn what we possibly can about the nature of the ailment and its prevention —in so far as common salt can be of any assistance to us.

How often has not my assertive inquiry about a susceptibility for "catching cold" been answered in the affirmative! In most persons with an anæmic appearance I have discovered, if not a dislike or a positive aversion to salt, at least a great indifference about its use ; and invariably, this indifference was accompanied by the susceptibility for "catching cold". Let us see whether we can find an explanation for this.

An observation under the microscope will show us the blood corpuscles in their normal shape ; and also that, being ductile and elastic, they can easily alter their form to pass through the fine capillaries of the tissues. When, however, the blood is insufficiently supplied with common salt, or, stating the case in another way, is in a watery condition, the corpuscles swell, become distended into a globular and more unyielding shape, and thus lose the facility of accommodating themselves to the minute interstices of the tissues.

With the blood in this condition, let a draught of cold air strike the body in any part for a more or less prolonged period ; or, let part of the body, for example the face, be exposed to a low temperature—it will not be unreasonable to assume that the contraction of the capillaries, resulting from such low temperature, will cause a check in the circulation, owing to the blood corpuscles not being able to pass through these contracted capillaries. If this impediment to the free flow of the blood lasts a sufficient length of time, the tendency to the coagulation of the blood will have an opportunity to become active, thus establishing a serious disturbance to the circulation.

In the face this impeded circulation will cause an effusion of mucus or phlegm from the nostrils, or it will cause an exudation in the throat, and this, becoming viscous, will produce hoarseness in the voice, besides leading to a cough, both symptoms often relieved by expectorations. If the ailment extends further down the windpipe the bronchii may become affected by more serious symptoms. From my own experience I would say, that the symptoms assume a serious character only, when through indigestion the system generally is out of order.

In the muscles the impeded circulation produces a more or less greater rigidity, and in the joints it evinces its effect in a stiffness and painful resistance to movements.

When the blood is not overcharged with impurities, such an attack will yield to one or two days' rest and perspiration in bed, or to a hot-air bath, or to muscular exercise with free diaphoresis—to, in fact, a "de-watering" of the organism, by which the common salt in the blood will obtain a greater concentration, restore the corpuscles to their normal shape, and dissolve the semi-coagulated plasma. I contend that the presence of common salt in sufficient quantity *would have prevented the "catching cold"*.

CHAPTER XXXIV.

RHEUMATISM AND GOUT.

In cases of an impeded circulation, as referred to in the previous remarks, in which, however, *the blood is surcharged with undigested*, or *imperfectly digested albuminoid matter*, or in which the *ultimate products of the metamorphosis* of the tissues *have accumulated*, have *not been completely oxidised* and *have not been eliminated*—all this again the result of an insufficiency of common salt in the blood—in such cases the check in the circulation will produce rheumatism, gout or many local morbid affections; it may lay the foundation for inflammation of the lungs, and be productive of the many serious ailments, morbid deposits, swellings, tumours, etc., and leave often permanent afflictions behind for the rest of the sufferer's life.

This picture is by no means overdrawn; on the contrary, it rather fails in enumerating the serious results, which may be the ultimate *outcome of a simple "cold" upon a deficiency of common salt in the system.*

If, with such a deficiency of salt and an accumulation of albumen in the blood, a stagnation, or even only a partial check to the circulation occurs, under circumstances, such as a general exposure to a damp locality with a low temperature, for example, remaining in wet clothes in cold weather, sleeping in a damp bed: rheumatism is sure to be the result. Under such conditions the blood plasma will transfuse through the walls of the capillaries, and the fibrin will coagulate. This morbid process is referred to by Sir James Paget[1] in his remarks on the effusion of serum, when—he says—after a time "the tissues are found indurated and adhering, the œdema" (swelling, enlargement) "having consisted in the effusion of serum, which has coagulated and become organised in the seats of the effusion. Thus too, it is, that the damage done by rheumatism in a part, is, on the whole, in direct proportion to the length of time it has subsisted there, and *the opportunity given by time for the coagulation of the fibrin.*"

And when Moleschott tells us,[2] that the synovial fluid, which bathes the moving surfaces of the various joints, contains proportionately the greatest amount of albumen as compared with any other part of the body, we can readily understand the great liability of the joints to be affected by a deficiency of common salt in the system, since the salt keeps the albumen in a fluid state.

That such affection of the joints is not merely a local phenomenon, but is dependent on the general state of the blood, is evidenced by the fact, that such rheumatic attack takes place in a number, if not in all the joints and simultaneously in the heart, although the latter has no direct anatomical connection with the former. If now furthermore the blood contains an abnormal amount of urea and uric acid, which are unquestionably a poison to the system (and not being secreted by the kidneys for want of the necessary sodium-chloride), we can find an explanation of the pain resulting from rheumatic and gouty affections, caused by these poisonous substances acting on the nerves.

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[1] Paget, *Surgical Pathology*, i., pp. 327-8.

[2] Moleschott, *Kreislauf des Lebens*, p. 51.

On the whole then we may safely conclude, that want of common salt in the body is one of the principal factors (with surcharge of albuminoids and want of exercise) in the production of rheumatism and gout, and that hence a liberal supply of the mineral to our organism protects this latter against those maladies.

We may recall to our mind Prof. Beneke's advice to the effect, that the continuous use of a weak solution of common salt is the natural remedy for the various rheumatic affections, so far as medical science and art can decide at present, if it ever will discover any better remedy than sodium-chloride, combined probably with hot-air bath, exercise or massage as the individual case may require.

A rheumatic patient is carried into a hot-air bath. He perspires; all that happens to him is, his system is deprived of water; but the density of the sodium-chloride is thereby increased, the coagulated muscular albuminoid (the myosin) regains its fluid condition, the muscles become supple and the patient, who was carried into the bath, walks out again.

The warm brine baths at Droitwich extract water from the body, whilst at the same time impregnating the system with common salt, and so effect the cure of rheumatism.

Prevent rheumatism by a liberal use of common salt.

CHAPTER XXXV.

SALT AND DROPSY.

IN the above category of ailments we may perhaps include one of the sequelæ of rheumatism, namely, *dropsy*.

Whether we trace the inciting cause of this form ot disease to the failure or weakness of the heart, or to a disturbance in the function of the kidneys—both referable to a watery condition of the blood—we can in the first instance find in common salt a factor, which can assist us in the prevention of this affliction. We cannot be far wrong when we assume, that it acts when present in sufficient quantity, directly by promoting diosmosmic action, and indirectly by its beneficial influence on the heart and on the kidneys.

It is not improbable that the accumulation of an abnormal quantity of fluid in the system is owing to the pores of various membranes being obstructed by the albumen of the serum, which, for want of sufficient common salt, has assumed a viscous—a semi-coagulated—condition. This is, to some extent, inferentially confirmed by the unquestioned fact, stated by Navratil,[1] "that an abnormal supply of liquid results in cardiac hypertrophy and a fatty degeneration of the heart, independent of any organic substance contained in the liquid ; and it has been observed that, with an enfeebled heart and the appearance of dropsy, *a reduction in the amount of liquid taken, increases the amount of urine execreted, and thus causes the gradual disappearance of dropsy*".

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[1] Dr. F. Navratil, *Die Behandlung des Menshlichen Gesammt-organismus*, Leipzig, 1891, p. 34.

From what we have learnt about the balance, existing in the human body between water and common salt, we can understand the effect of a deficient supply of water to be equivalent to either an increased supply or, what is *de facto* the same, a greater concentration of salt in the system ; and this would tend to dissolve the semi-coagulated albumen, open the clogged pores of the membranes, promote transfusion of the serum and likewise the action of the kidneys, and thus cure dropsy.

It is not saying too much when again we declare, that common salt is one of the chief factors for the prevention of disease.

CHAPTER XXXVI.

ANÆMIA AND CHLOROSIS.

WE have already ascertained, what direct influence sodium-chloride has on the colour of the blood. This will, very naturally, lead us to infer, that with the blood, the colour of the skin will also be improved by the liberal use of common salt; and that this healthier appearance is an indication of an improved state of the system generally. It will further induce us to conclude, that we have in sodium-chloride a means for beneficially influencing that malady of the system called: anæmia and chlorosis.

There is, however, a deeper physiological reason for assuming, that common salt is, if not a positive remedy for the cure, at all events a great aid in the prevention of the disease.

"Anæmia" means "without blood," but more correctly, "poverty of blood". Its symptoms are, a general feebleness, physically and mentally—hence incapacity for any exertion; want of, or a diminished appetite; palpitation of the heart; headache; and sometimes fainting fits and convulsions; in fact a low vitality, manifesting itself externally in a general pallor of the face, with more or less absence of all colour from cheeks and lips. We can easily understand that these symptoms result from a deficiency of red blood corpuscles, when we recall to our mind their important function, to supply oxygen to the nervous system.

The malady can arise from many and various causes; it may be the result of a prolonged loss of blood, owing to disease or accident; this lies, however, outside our inquiry; or it may be a concomitant symptom of consumption, cancer or other constitutional ailment; or lastly—and for our immediate object of more importance—it may be the result of a disturbance in the process of digestion and assimilation of the food and thus of a retarded renewal of blood. In any case, a judicious supply of common salt will assist in restoring the appetite; in the formation of red blood corpuscles; in promoting the absorption of oxygen by these latter and thus stimulating the various functions, which tend to restore and maintain the body in a normal healthy condition.

Especially in cases of chlorosis (green-sickness, mostly met with in young girls at the age of puberty), it will be found, that the administration of common salt by means of the salt bath, but still more so by internal use in solution, will be of great utility to combat the symptoms.

The recognised medicine in cases of anæmia and chlorosis is *Iron*, which is administered in different preparations. Iron (as we know), in a combination with albumen as hæmoglobin, is that constituent in the blood corpuscles, which is the carrier of oxygen, and although in some cases of the malady it has been found of benefit, in others it has completely failed.

" When in cases of chlorosis and other forms of anæmia it is found, that iron fails in many instances, this is perhaps owing to the fact, that it is not always possible to discover the exciting cause of anæmia; and secondly, that in the formation of a healthy blood corpuscle, *other factors come into play besides the mere supply of the required ingredients*."[1]

In one form of the malady it is found, that the blood contains an abnormal quantity of white, as compared with the number of red corpuscles, evidently the result of a check in the formation of the latter.

Remembering now the important office which common salt fulfils in the blood, and its acknowledged influence on the formation of the red corpuscles, we can certainly not err very greatly if we surmise, that the presence of sodium-chloride has in some, as yet unexplained, way an influence on the building up of the hæmoglobin, in short, on the birth of new red corpuscles ; and that, for want of sufficient supply of salt, the iron has proved ineffective.

Prof. Beneke[2] deals with this subject very exhaustively. He confirms, what was stated above, that, " a careful investigation and observation of cases of chlorosis soon shows, that we have to deal here with quite different conditions, and that after all only a small number of chlorotic patients present cases in which the pallor is owing to want of iron in the organism ".

And further on he calls attention (as one cause of chlorosis) to the " undoubted fact, that individuals, who suffer much from acidity in the stomach, show a pallor in the face ; and this acid fermentation is mostly produced by the frequent use of carbonate of soda, which furthermore acts detrimentally on the liver.

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[1] H. Quincke, *Ueber Eisen-therapie*, *Sammlung klinischer Vorträge*, No. 129, p. 343.

[2] Beneke, *Gr. d. Path. d. St.*, p. 389 *et seq.* A work which bears on every page the impress of the observing and thinking physiologist.

" This effect of lactic, acetic and butyric acids would be not so much to check the formation, as to accelerate the destruction of the red corpuscles and the abnormal excretion of iron."

Here again we can point to the good effect, which common salt has on the digestive organs in correcting and preventing this acid fermentation (see pp. 113-4), and thus preventing anæmia and chlorosis. Prof. Beneke relates,[1] that " in cases of chlorosis combined with obesity, iron has often been administered for several months with the least effect " ; whereas a comparatively short use of Carlsbad or diluted Friedrichshall water met sometimes with " prompt success ". Now, one of the chief ingredients of these mineral waters, especially the latter, is sodium-chloride.

He further relates : " I had other cases, which, probably owing to the presence of scrofulous symptoms, were sent to a mineral bath (Sool-bad, *i.e.*, common-salt bath). The patients took no iron, but bathed, and the result was the disappearance of the chlorosis, with accompanying regulation of the menses."

Enough to show that, although iron may be necessary, the administration of common salt assists in preventing (and curing) anæmia and chlorosis.

The effect of the daily dose of a salt solution is so manifest, that in most instances I have been able to announce, from a mere inspection of the face, whether or not my advice of its daily use had been followed. There are certain parts of the face, which more than others indicate, by a peculiar deep paleness, the poverty of the blood ; and it is in these parts that, after two or three weeks' use of salt, the skin assumes a healthier hue—a pink colour has replaced the paleness.

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[1] Beneke, *Bal. Br.*, p. 92.

I cannot resist the conclusion, that, generally, the healthier tint of British ladies, when compared with their continental sisters, is due to their being more exposed to the salt air of the sea ; they inhale the common salt in the act of breathing the salt-laden air, which the wind wafts over the land from the proximate ocean. On the whole then, it only requires a trial ; it is so simple ; not the least harmful, and involves no professional fee, although this is rather a disadvantage. If the advice had to be paid for with a guinea, it would receive better appreciation ; and if the ingredient recommended, instead of being in every kitchen, had to be purchased in bottles, with a Government stamp, at 2s. 9d., or 5s. 6d., under an imposing scientific name, as hygienic, or as grape, or any other salt, it would be looked upon as of mystic value, and religiously used.

Mundus vult decipi—ergo decipiatur.

We could extend our inquiry about the influence of common salt to other diseases which proceed from causes within the body ; but there will be no need for doing so since they arise either

From a general indigestion, due to the inaction of the secretory glands ; or

From want of hydrochloric acid in the gastric juice (causing many insidious chronic constitutional afflictions) ; or

From inaction of the secretory function of the liver and the kidneys ; or

As the result of distended blood globules (including—besides : dyspnœa, spasms, heart failure, apoplexy, syncope, fainting fits—many other ailments; all for want of oxygen in the blood); or

Are the consequence of a more or less extensive semi-coagulation of the plasma (as manifested in rheumatism, gout, dropsy, etc.);

in all these cases we have found, according to our past inquiry so far, that a deficiency of sodium-chloride may enable us to explain the etiology of these various maladies, and that a great many other forms of disease, not enumerated above, arise from one or the other of these exciting causes.

Our attention will now be claimed by another class of disorders, *viz.*, the infectious diseases, which it is assumed are caused by an organic germ, that has entered our body, and has set up different morbid symptoms. To this class belong the various forms of fevers, with or without an eruption on the skin, *viz.*, small-pox, measles, scarlatina, typhus and typhoid (or enteric) fevers, besides cholera, influenza, diphtheria and several others.

But before entering on the inquiry into the nature and character of only a few of them, there is a question in relation to these maladies, which demands elucidation, since it is of paramount importance for our estimation of this class of ailments in special relation to the chief object of our inquiry, *viz.*, the office which sodium-chloride performs in the human organism.

CHAPTER XXXVII.

INDIVIDUAL IMMUNITY.

In the whole domain of human physical suffering from disease of every kind caused by agencies or influences, whether of internal or external origin—affecting the health and the life of the organism—no question deserves our attention with a greater claim to importance, than that of the immunity, the insusceptibility which we meet with in many individuals.

It cannot have escaped even the most superficial observer, that different people are differently affected by one and the same pathogenic influence, such for example as a simple current of cold air. Of, let us say, three people exposed to it, one becomes dangerously ill, contracts perhaps influenza, which brings him to death's door, and, after seriously suffering for several weeks, remains with a shattered constitution. Another escapes with a severe cold, troubling him for three or four days, perhaps a week at most, but recovers without any further consequences, whilst the third has not felt the least inconvenience from it.

It was not the cold air which determined the effect on the individual sufferer; but there was something—either present or absent—in his system, which caused the body of each to yield to or to resist the action of the low temperature. In fact, this latter, whilst morbidly affecting one person, would beneficially invigorate another. It was the same agent which acted on all three; and the only, and most rational way to explain the difference in the effect produced, is: by assigning to each one a different susceptibility to the low temperature.

If I give such an importance to this subject, it is of course with the intention of showing the very close connection, which exists between this individual immunity and the presence of common salt in our body; and in this view I am supported by such good authority as that of the late Dr. E. Lankester, who, when dealing with this question of the difference in the susceptibility to disease, lays special stress on the necessity of the inorganic constituents of our food for our well-being.[1]

He insists on the importance of the various salts in the human body, "without which," he says, "we cannot live. If you will persist in rejecting the salt, and avoiding the liquor that meat is boiled in, you may get albumen, fibrin, but none of these other substances; and then the first attack of fever or cold may prove fatal. Four men shall be travelling outside an omnibus—one may get acute inflammation of the lungs, another bronchitis, and the other two shall come off free. Was it the riding outside the omnibus that caused the two to fall ill? No, it was the state of their blood. They had lived somehow irregularly; somehow their bodies had been deprived of their proper constituents. So you may find half a dozen children, all exposed to the contagion of scarlet fever; two take it—one dies, and the other four are free, but the two, that have caught it, have lived in such a way, that their blood has really taken in the contagion; and the one that has died has got into a condition which has produced death."

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[1] Dr. E. Lankester, *Lectures on Food*, 1st course, London, 1861, p. 35.

Dr. Lankester could not have expressed himself in more unequivocal language to the effect, that the disease, following the infection, is determined by the individual susceptibility.

And this difference in the body's susceptibility we meet with in the case of all, even the most fatal infectious diseases, which gives this question its pre-eminent and far-reaching importance in every inquiry into the cause and the prevention of disease; and what must surprise us is the neglect, which this aspect of medical science has met with on the part of the faculty.

If during an epidemic in a city or a district 93 per cent. of the inhabitants escape, although there can be no doubt about the disease germ having entered their system (of which we shall have immediately reliable evidence), and only 7 per cent. are attacked, and of these one half die and the other half recover—would it not be the dictate of common-sense and of all higher logic to inquire into the state of the constitution, which protected the ninety-three, and apply the result of such inquiry to guard the seven, who are liable to an attack? You will, I have no doubt, answer in the affirmative, and perhaps smile at such a question being raised, since it appears self-evident.

Such is not, however, the view of medical men. Instead of applying themselves to the above inquiry, to ascertain the cause of the natural insusceptibility, they direct their energies to the discovery of the pathogenic microbe; experiment upon its natural history, its propagation, is vitality, its virulence, etc., and deal with it in extensive treatises, elaborate dissertations and learned disquisitions; warning us, in all seriousness, to avoid the ubiquitous bacillus.

Do not go into or near a house—they advise us—in which the disease has found a victim; do not receive a visitor from such a habitation, such a street or such a city. Investigate or shun every article (even letters, reaching you from an infected place) which may convey the morbid germ; avoid every material substance, that has passed through hands, which *might* have conveyed to it the microbe; eat no vegetables or fruit, unless you are sure of their not being "general providers" of the dreaded germs; in short, avoid everything and everybody, to prevent the disease germ entering your system, or you will—if not a dead man—be at least liable to an attack of the disease.

And the ninety-three "Immunes" mock the grand science of bacteriology by swallowing the bacilli—the disease-dirt—wholesale; and are ungrateful enough not to gratify the bacteriologist by even showing the slightest indisposition.

This ingratitude, it appears, is shown in relation to all the dreaded pathogenic germs, as we shall experience in our inquiry into the nature and prevention of the several maladies, which are the consequence of such germs.

As no disease will afford us a better illustration of this anomalous state of medical science than cholera, I propose to treat of this infectious disorder in relation to the effect, which sodium-chloride has shown in its treatment.

CHAPTER XXXVIII.

CHOLERA.

ALL honest physicians, except the "infallible doctors," candidly admit that "we have not yet understood the disease, nor do we know how to treat it" (Dr. Mitra); ". . . that we are literally powerless against the developed cholera case" (Dr. Rossbach), etc.

In a treatise, published in 1894, I have dealt with the question of the nature and the prevention of cholera to a fuller extent than I can do here; and to that treatise I have to refer you for further information on the subject. Here I must only repeat what is essential to our main object: how far we can expect to prevent the malady by the liberal use of common salt.

This disease had puzzled the European physicians for over fifty years until Dr. Robert Koch discovered the cholera-bacillus; and now all their efforts are centred on the diagnosis, to ascertain whether in a choleraic attack the bacillus is present. This is a highly scientific procedure, and demands great skill; but the treatment, with the object of saving life, has not gained by the discovery; since as before, so still now, "50 per cent. of those attacked are doomed to die" (Rossbach, 1886).

Such bacteriological researches often occupy twelve to twenty-four hours and more; it will give us time enough to contract the disease and die two or three times over.

"Sometimes it takes three, seven—yes, even fifteen days until the comma-bacillus is properly formed; it is hence prudent not to interrupt the observation too soon"—to save the patient's life? Oh, dear no! Merely to know whether it was cholera-asiatica or cholera-nostras that was the cause of death.

In London it costs the Government £5 5s. to ascertain this. For what purpose?—this goes beyond a layman's comprehension.

This cholera- or comma-bacillus must hence be a formidable creature, and if we—or the doctors—could only get hold of it there might be a chance of exterminating the disease altogether.

But beware of the cholera-bacillus.

From the above you will naturally conclude that, when swallowing these microbes, you are sure to have an attack of cholera. Yet with all this fussy importance about the dangerous character of this disease germ—in spite of all the congresses, conferences, inquiries, and Government instructions of precautions—the bacillus has been swallowed wholesale by experimenters in the laboratories, and accidentally by non-experimenters, without the least morbid consequences. The former, the locality of the laboratory, may not be favourable for developing the disease; but during the Hamburg epidemic, which certainly offered all the external conditions for producing cholera, "*a child swallowed the choleraic-dejecta of the father*" (mistaking it for gruel) "*without suffering in the slightest degree*".

Nothing will place the whole medical question of cholera—its etiology, prevention and treatment—in a clearer light than the following account of an epidemic in Kashmir in 1892, as reported by Dr. A. Mitra. It completely annihilates the vaunted "dirt theory" which found its chief advocate in the late Mr. Ernest Hart.

"The Kashmirs are notoriously filthy, and 125,000 of them are crowded into the city of Srinagar" (the capital of Kashmir), "which is about the centre of the valley, is two miles long, and a mile and a half in its widest part. The city is built on both sides of the river Yhelum, and through the city also runs a canal—the Nalla-Mar—which was once used as a water supply, but now is but a string of cesspools. The population is crowded into 2500 low dirty houses, built irregularly in narrow lanes and alleys, which are used as latrines. There is no drainage, and the storm-water washes the filth and ordure into the Nalla-Mar and into the river, from which the drinking water is obtained; the beds and clothes of patients and the bodies of the dead are washed in the river and canal, from which water was drawn for drinking and domestic purposes; and the dejecta, of many cases (of cholera) in the boats on the river, were thrown into the water, while drinking water for the patients was taken from the same spot almost simultaneously."

It will be almost impossible either to find naturally, or produce artificially, more favourable conditions for the development of cholera, than those stated above, and it is a wonder *that not all the inhabitants of Srinagar succumbed to the disease*, as, from the threatened omnipotence of the bacillus, might naturally be concluded.

Instead of this: 93 per cent. escaped, and the disease died out with, no doubt, cholera-bacilli left in plenty in the bodies of the survivors; of the total population of Srinagar only 7·2 per cent. were attacked, and 4·6 per cent. died.

The *decline of the epidemic was due not to any absence of filth and of cholera poison, but simply to the fact, that the disease had carried off all the persons, who were susceptible to it.*

But after all the weighty admonition against the poisonous germ, medical men themselves admit that this latter does not always produce an attack. Dr. O'Sullivan, referring to the Hamburg epidemic, remarks: "It by no means follows, that all persons, who swallow the bacilli even in considerable quantities, necessarily develop cholera. The Hamburg statistics tend to confirm, what has been noted in preceding epidemics, namely, that out of any community, exposed to the necessary influence, not more than about 5 per cent. contract the disease (in Hamburg only 3 per cent.). This means, that only such a percentage of persons have the requisite predisposition." He very significantly adds: "What precisely constitutes this predisposition to develop cholera is as yet a disputed point".

Prof. Hueppe supports this view; he says: "When we take into account all the various cases, we are forced to conclude that, with such widespread possibility of infection, the number of infected cases, which showed no morbid symptoms, must have been a far greater one".

So also Rossbach declares that "we are hence forced to assume, that there are human beings, who are insusceptible to cholera, who even, when infected, do not develop the disease".

In a volume, issued by the German Imperial Board of Health,[1] is reported an instance (one of many), where

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[1] *Arbeiten aus dem Kaiserlichen Gesundheitsamte*, Appendix (to vol. x. ?), p. 148.

"in a family of ten persons two were attacked. *The dejecta of the other eight were found to contain the comma-bacillus:* three of these eight had loose and one had firm evacuations. The presence of the bacilli in this instance entitles" (forces) "us to assume, that during a cholera epidemic," therefore the most favourable time for the disease, "a far greater number of people are for the time being invaded by the cholera vibrio, than there are cases of illness."

Yet the advice given in the same volume, directed chiefly against the possibility of coming in contact with this "vibrio," and extending over several quarto pages, completely *ignores the harmless character of the disease germ against a natural immunity*, or more positively expressed: the advice ignores *the protection which a natural immunity affords against the disease.*

And this insusceptibility has been observed ever since cholera entered Europe; the *Med.-Chir. Review* of 1831, p. 285, contains a letter (written from Moscow by Mr. R. Hermann to Dr. Todd), in which the former states "that the disease can only be developed under a certain predisposition of the constitution". And he adds: "It appears that in Moscow three individuals out of one hundred possessed this susceptibility for the disease". So that in Hamburg we find three, in Moscow also three, and in the dirtiest and filthiest of all places, Srinagar, 7·2 per cent. of the populace susceptible. Let us say that on an average 5 per cent. are attacked and 95 per cent. escape.

It is unquestionably quite evident, that these ninety-five did not escape an attack through a mere lucky accident; but that the greater number of them certainly were protected against the disease through a natural immunity. This is fully confirmed by the late Dr. B. Hawkins,[1] who relates in his account of the epidemic in Russia in 1831, that "during the prevalence of the epidemic, there was scarcely a single inhabitant of the city of Orenburg, who had not symptoms of disordered digestion. These trifling symptoms of disease were usually ascribed to errors in diet. But to me it appeared that their cause was a general invasion of the system by cholera, which, however, was prevented from developing itself in its perfect character by a regular manner of living and other circumstances of the kind." In other words, *they were protected by an immunity against the pathogenic poison.*

And what is stated here of cholera, applies to a greater or lesser extent to other infectious diseases.

On the one side we have 5 per cent. of people, who suffer from an attack owing to their predisposition; some only slightly, others severely, and about half the number succumb to it and die.

On the other side we have 95 per cent. who escape; who, although the poisonous germ enters their body, do not develop the disease through some peculiarity in their organism, which imparts to them a fortunate immunity. The poison has passed through their system (in the words of Prof. Virchow) without doing any harm.

Very naturally you will ask: What is this peculiarity in the constitution, that protects the human body against the disease germ? I have failed to discover any attempt on the part of the medical profession to investigate this question. All endeavours have had for their object to determine the influence which *agencies outside the human*

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[1] Dr. Bisset Hawkins, *History of Epidemic Cholera in Russia*, London, 1831, p. 106.

body have upon the vitality and the virulence of the "vibrio" and on the severity of the attack; but the inquiry into the nature and cause of the susceptibility of the human body has been neglected. Experiments without number have been made on rabbits and on guinea-pigs; a thousand and more books and dissertations have been written, published and discussed, all with the object—of what?—to find and kill the bacillus. The former is impossible when inside the human body; and the latter can only be done by killing the host, who harbours this terrible creature. And all the experiments and writings are mocked and derided by the child, who swallowed the father's excreta and did not have an attack of the disease.

Do not, pray, accuse me of assigning too much importance to this question of the individual immunity. The above remarks apply, as already stated, to most other infectious disorders; but even in relation to cholera, they deserve our fullest attention. We, in England, may for the time be free from the infliction; the sanitary condition of the greater number of cities and towns may be a guaranty, that cholera cannot easily become epidemic amongst us. But we have to care for the natives of India, our soldiers, and the numerous Europeans, who are exposed to the vicissitudes of an unhealthy climate and often more unhealthy local conditions.

When in face of the unquestioned failure of the medical profession in the successful treatment of the disease (as evidenced in India and elsewhere) any attempt to throw light upon the subject is answered by the assertion that "legitimate medicine has long settled the proper treatment"; or "the disease has to be treated according to the recognised principles of medical science"; and when the application of these "recognised principles" only betrays the impotence of that "medical science," and proves the want of any physiological basis for its adoption, it can excite our contempt for such unfounded ostentation. And where is the proof to verify the claim to so much perfection?

"Dr. Holmann de Villiers published in the *Sem. Med.* a method of treating cholera cases, which has been tried by Dr. Lambotte in Antwerp. Dr. Lambotte took two patients, made an incision of 3 cm. in the abdomen, and another of 1 cm. in the inner lining membrane, pulled out by means of pincers the small intestines, fastened these to the abdominal wall, and by the employment of suitable instruments, washed out the intestines, first with a solution of sublimate (1 : 3000) and immediately after with a decoction of coffee, peppermint tea and water, then replaced the intestines and sewed up the aperture. Both patients died."

The *Deutsche Med. Wochenschrift* (No. 22, 1892, p. 863) adds sarcastically: "Wir bringen diese Thatsache nur, um sie niedriger zu hängen".[1]

In the *Medical Press* of 2nd Sept., 1892, p. 237, etc., appear "Some Suggestions on the Treatment of Cholera, by John R. Burke, M.D., Retired Deputy Inspector-General of Hospitals and Fleets, R.N.". The suggested treatment consists in the application, besides sundry processes, of about twenty or twenty-five different remedies —from hot punch, red pepper, ox-gall, etc., etc., to calomel, morphiae-hydrochloratis and other poisons. The author assures us that "the component parts" (of this treatment) "have received the sanction of the highest authorities".

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[1] This expression is adapted from an anecdote of Frederick the Great, who had a pasquil upon himself placed lower, that the people might see it better. Insusceptibility for "Lèse Majesté" does not appear to be inheritable.

Medical men would not dare to make these public statements about the certainty of their art, which are so glaringly contradicted by evident facts, were they not conscious of the ignorance of the laity. Is it a wonder that laymen resent at times the supercilious manners of certain members of the profession, and assume a militant and almost hostile tone towards the "doctors"?

Let me now give in a condensed form the result of my inquiry into the nature of cholera; then state the reason for considering sodium-chloride a prophylactic against the disease; and lastly bring evidence forward, from the latest medical treatment of cholera, in support of my contention.

For a verification of the following statement, I must refer you to my treatise on *Individual Immunity*, where I have given the scientific data on which my conclusions are based.

All latest researches lead us to infer, that death in the case of cholera is not caused by the loss of water from the blood, nor is it the result of the pathogenic poison acting on the nervous system. It cannot be doubted, that the morbid alteration of the blood is the chief factor and the dangerous moment in the development of the individual cholera case.

" . . . a mortal coldness with the arrest of the circulation *comes on from the beginning*, and the patient dies without a struggle" (Dr. Hawkins, p. 62).

And Dr. H. Kennedy declares: "It is more than probable that these" (diarrhœa and vomiting) "are merely the *first perceptible* symptoms, for it would appear, that a great change *has already* taken place in the circulatory system, and that the action of the heart itself has been greatly diminished before they occur".

All phenomena of a choleraic attack indicate, that the blood has lost its function of absorbing oxygen and giving it off to the various tissues, in consequence of which weakness of the heart, stagnation of the circulation, lowering of the temperature, cessation in the metamorphosis of matter, and arrest in the secretion of the kidneys with all the other morbid symptoms are the result.

Already in the earlier attempts to define the nature of cholera, attention was specially directed to the condition of the blood. In the report of Drs. Russell and Barry in a circular of the General Board of Health (Dec., 1831) it is stated :—

"The blood ceases to circulate; its physical properties are altered; . . . the secretions are all arrested and animal heat is no longer produced".

The most definite statement, that the mortal symptoms must be looked for in the blood, is expressed by Dr. Mireur,[1] who, as the result of investigations on the condition of the blood in cholera patients, declares :—

"*We have found this alteration of the blood in all cases. We are hence inclined to regard it as characteristic, as a pathognomonic lesion of cholera.*"

Knowing the important function which common salt fulfils in the human body, what more natural than to infer that its absence, or more correctly its insufficiency, should be the cause of the susceptibility for the disease, and, as a corollary, that its presence in sufficient proportion protects the blood corpuscles, not by killing the vibrios (which by-the-bye are never or seldom found in the blood), but by strengthening the corpuscles through the abstraction of the watery serum?

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[1] Dr. H. Mireur, *Etude sur la Prophylaxie et le Traitement du Choléra*, Paris, 1884, pp. 25, 26.

This suggestion has been met by the assertion, without being backed by evidence, that "it is a certain point, that common salt can have no preventive influence". The so-called saline treatment, which mixed carbonate of soda, seidlitz powder, Epsom salt, and even a potash salt with the sodium-chloride (and using this latter in the least proportion), I have exposed in my treatise as unworthy of our notice; it is saline as far as the name can be given to it, but it is, as it has proved, useless.

If we now inquire into the latest achievement in the treatment of cholera, we shall learn with astonishment, that, after all other attempts to beneficially influence the course of the disease have failed, the only remedy left is: *common salt in solution, injected subcutaneously or intravenously, as the one reliable means for combating the disease and saving the sufferer's life.*

Thus we are informed, that in Hamburg in 1892, Dr. Rieder "introduced into practice the intravenous injection of a solution of common salt into our cholera therapeutics, as other means, hitherto applied in the treatment of the disease, had given very unsatisfactory results.

"With the truly wonderful momentary success of the injection, it was not surprising, that it should find immediate application on an extensive scale. It was carried into effect with the usual physiological common salt solution. An addition of sodium-sulphate, as recommended by Hayem, gave no better results, and was soon discontinued. Also other medicinal additions were tried, such as thymol, peroxide of hydrogen, without being more effective, and hence were discontinued."[1]

In the same volume Dr. G. Hager[2] expresses himself in similar terms; he says: "Of all the therapeutic means used in the treatment of cholera, the infusion of a solution of common salt deserves unquestionably special regard; firstly, because it is the only means which is capable of influencing the disease; secondly, because we can give a scientific explanation" (about which see below) "of its favourable effect; besides which it is just the remedy to attack the disease in the most critical period".

It is significant, however, that in the next sentence Dr. Hager declares: it is chiefly the artificial supply of water, to compensate for the loss of water from the system, which is aimed at, and not the supply of sodium-chloride to the blood. "The well-known 0·6 per cent. solution of common salt," he says, "*was chosen*, and the addition of other *medicinal substances*, camphor, sodium-sulphate, *which were tried*" (wonderful science!) "could not be recommended."

Common salt was chosen. As if there could have been a choice except for the ignorant "Empiric," who tries, without being guided in his choice by scientific knowledge. It is not to the credit of medical science and medical skill, that only *trying it* led to the adoption of the means, which a more circumspect knowledge of physiology and of the nature of the disease should have dictated.

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[1] Dr. Sick, "Die Behandlung der Cholera mit intra-venöser Koch-salz-infusion," *Jahrbücher der Hamburger Staats-Kranken-Anstalten*, vol. iii.

[2] Dr. G. Hager, "Die Infusions-therapie der Cholera behandelt nach 967 Fällen," *Jahrbücher der Humburger Staats-Kranken-Anstalten*, vol. iii.

During the time of the Hamburg epidemic Dr. Daremberg[1] published a small work, in which he declares that, as all other remedies had proved unsuccessful, he at last resorted to salt-water injections with most favourable results. And the *British Medical Journal* (20th Nov., 1897, p. 84) copied from *Sem. Med.* a report according to which Loin of Brussels has had recourse to subcutaneous injection of normal saline solution in a case of infantile cholera, and in a few days the patient recovered.

It is incomprehensible on what grounds the leaders of the profession, after such evidence and extensive experience, as is now available, should oppose a systematic trial as suggested by me[2] with the object of fully and incontestably establishing the fact: *that a sufficient and systematic supply of sodium-chloride to the system is a prophylactic, and imparts to the human body an immunity against cholera and allied diseases.*

The following paragraph which appeared in *The Lancet* (23rd Oct., 1897, p. 1076) will give food for reflection :—

"*Cholera in India.*—The news from the headquarter half of the 1st Battalion of the Shropshire Regiment stationed at Sitapur, not far from Lucknow, North-west India, shows that a severe outbreak of cholera has occurred. It is reported that *forty non-commissioned officers and men have died from cholera.* It is too early to learn any details, but assuming the outbreak to have been a very sudden one, it looks like water poisoning ; but if that be so, how did it occur on such a scale? Sitapur is, generally speaking, a healthy station, and how did the *comma-bacillus* gain an introduction into the affected community?"

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[1] Dr. G. Daremberg, *Le Cholera*, Paris, 1892, p. 184.

[2] *Natural Immunity*, p. 61.

Forty men died from a preventable disease.

What a loss of human lives—and money; each soldier is worth to his country at least £250.

And where was the "Brigade-Surgeon Lieutenant-Colonel"? Where? To inquire into it:—

> Um es am Ende gehn zu lassen
> Wie's Gott gefällt.

CHAPTER XXXIX.

TYPHOID AND OTHER FEVERS.

ALL that I have said in my attempt to impress upon your mind the importance of the individual predisposition, as the principal factor in the production of cholera, applies in an equal, if not a greater degree, to typhoid and other fevers ; and when I instance dirty Srinagar to illustrate my remarks, I do so as an example which cannot be contested.

But no one, except his mind is bent on a wilful distortion of my remarks, will accuse me of preaching the maintenance of filth, and of defending carelessness and neglect, which lead to the pollution of drinking water. Being, however, convinced that it will be possible to protect human beings against the infectious diseases, by ascertaining the cause of the natural immunity, possessed by the great majority of the people, and applying the result of such inquiry to the small suffering minority, I should be wanting in courage, were I to remain silent for fear of the anathema of the "legitimate doctor," who hunts the bacillus, and loses himself in bacteriological experiments, instead of applying his energies to the cure of the affected and to the prevention of the predisposition, the true province of his science and his art.

In cases of typhoid epidemics, as it has been in Maidstone, it is for the "doctor" not a question of how to protect the human body and make it insusceptible against the morbid poison ; the whole professional science is applied to a search in every nook and corner, in every well and water-course, every privy and cesspool, to discover the typhoid-bacillus, the poison, which affects the five, say even the ten, and is harmless to the ninety. What a waste of energy, both mentally and financially, is this bacillus-hunt. And when the microbe is found, is any single person protected against an attack, or any suffering patient thereby wrenched from the arms of death?

My object in making these remarks is not to detract from the responsibility attaching to the medical profession at large ; *all sensible people recognise this.* But the intelligent portion of the public refuses to acknowledge any merit in being led into a side issue ; to applaud a physician for stepping outside his province, and for thinking, that he has done his duty by merely pointing out, how a water company, or a sanitary engineer, or a builder has been at fault.

In *The Times* of 12th Dec., 1871, during the illness of the Prince of Wales, an article appeared on "Villa Residences and Typhoid Fever," the tone and style of which seems to betray the pen of a medical man, lately deceased. In the article it is lamented that: "public opinion is not sufficiently advanced to enforce the suggestion made long ago by one of the soberest sanitary workers in the kingdom, that *it would be well to hang one architect and one builder annually*, each selected for the purpose by his fraternity, until the survivors had *learnt the necessity of fulfilling in a proper manner the duties of their respective callings*".

I will withhold the epithet, which this sentence deserves ; but, without defending any architects or builders in their violation of honesty and in their blundering, I cannot help remarking that, so far as infection from zymotic diseases comes in question, they have 90 per cent. of the public on their side and might very well return the compliment.

Medical men are hence not justified in superciliously pushing aside and strenuously opposing any attempt at solving this weighty question of a natural immunity, and refusing haughtily their consent to any practical experiment, that may enrich our knowledge on the subject ; the less so, as those, considered as authorities in their own ranks, admit their inability to influence the course of the disease.

This is well expressed by Sir John Forbes[1] in his *Nature and Art in the Cure of Disease*, when he says :—

"In the zymotic or poisonous eruptive fevers . . . it is now universally admitted to be impossible to check their course, and all our most experienced and most enlightened practitioners agree that the terminations, whether favourable or unfavourable, are only very slightly modifiable by treatment ; and yet we find a large proportion of such diseases always terminating in restoration of health ".

So also an "Allopath," in a controversy about homœopathy,[2] expresses himself as follows : " . . . we 'Allopaths' . . . believe that, as regards the zymotic diseases, such as typhoid fever, for example, a poison or leaven enters the body, which latter thereupon undergoes a series of changes and tends to recovery, after a definite period, with or without the help or interference of the doctor ; no system of drugging shortens the process; the doctor takes care of"—nurses—" his patient, while Nature cures the disease".

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[1] Sir John Forbes, *Nature and Art in the Cure of Disease*, 2nd ed., London, 1858, p. 109.

[2] *Papers for the Times*, London, July, 1880, pp. 6 and 7.

This simple description of an attack of an infectious fever will serve our purpose of considering the nature of these diseases, of which the symptoms merge so much into each other, that in many cases it is difficult during the first few days to decide, whether it is a case of typhus, typhoid or recurrent fever.

A poison, a leaven or a germ (whether Eberth's or Klein's microbe, or Dr. X's or Dr. Y's bacillus) has entered the system, and the first intimation, that something is wrong, is a feeling of weakness--a general indisposition, accompanied by headache and loss of appetite. This, however, only occurs in a person belonging to the 10 per cent., who have a predisposition for the infection; the poison has no effect on the other 90. It (the poison) could not have passed through the stomach without being made harmless, unless the hydrochloric acid was absent in the gastric juice. Here we see the first influence of the presence of sodium-chloride as a factor for preventing an attack of the poison—the fever; and it must be mentioned, what Beaumont (cited by Moleschott) has observed,[1] that "the secretion of gastric juice is completely checked during febrile diseases"; to which Moleschott adds, that "in all diseases of this kind appetite is invariably absent".

From what we have learnt already we must conclude, that the administration of common salt in solution would be very beneficial in such cases, both for exciting the appetite and for the formation of the gastric juice.

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[1] Moleschott, *Physiologie der Nahrungsmittel*, p. 559.

Next we find in this class of disorders, that the formation of red blood corpuscles is retarded,[1] that the white corpuscles accumulate, and that these, so far as has been ascertained, probably form the pabulum for many of the products of the disease.

Here we must recall to our mind, that common salt, and especially the hydrochloric acid in the gastric secretion, when acting on the albuminous substances of the food, impart to them a vital stability, and that sodium-chloride is a necessary agent for the transformation of white into red corpuscles ; and we are thus led to believe that the body's ailment is partly owing to an insufficiency of common salt in the system.

I must here point out another phenomenon which is frequently met with in the two principal forms of these fevers, typhus and typhoid, namely: the diffusion of urobilin (the bilious colouring matter appearing in the urine) through the tissues and the skin, causing the latter to assume a yellow brownish tint ; and remind you, what we mentioned about the highly probable connection existing between the secretion of the bile and the nutrition of the nervous system. It would almost appear as if the diseased condition of the liver had caused the secretion of a morbid bile, which, besides affecting the intestinal canal, had—after reabsorption into the circulation—manifested its influence on the nervous system by causing the *stupor* (typhus), which gave the disease its name.

We further know, that common salt promotes the healthy action of the liver, and that it is a necessary ingredient of a normal bile. So again we may conclude that insufficiency of salt in the body imparts a predisposition for infectious fevers.

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[1] Bunge, p. 425.

If this conclusion is met by the remark, that it is only hypothesis, my reply is: that this hypothesis is, in greatest part, based upon established physiological and pathological facts; and that a few simple experiments —if these are not made impossible by a jealous opposition of the medical profession—will raise these hypotheses to scientific truths.

But let us see whether there are not some facts to be brought forward in support of the above "hypothesis".

Of the above-named fevers the recurrent fever is the mildest form; and of this Moleschott[1] remarks, that "in this fever as much, if not a great deal more can be achieved by nourishing food (during the fever-free intervals) than by quinine. According to the experience of Piorry, Gintrac and Larivière on the use of sodium-chloride in cases of recurrent fever, a food rich in common salt, such as salt meat, salt herrings, salt cod and caviar, should be recommended."

We would say, common salt solution, as not only the best beverage for the fever patient, but the most convenient procedure for furnishing salt to the system—not only in recurrent, but in all fevers.

And I believe to have seen sodium-chloride mentioned among the febrifuges in the list of therapeutic remedies.

The severest form is the typhus fever; sometimes (besides spotted, petichial, contagious, putrid or malignant, camp or jail, gastric) also called *famine* fever.

This latter name is in so far significant as it indicates the more or less exciting cause of the fever—want of food—the result of famine; either through bad harvest, as for instance in Ireland, or as the result of mismanagement of the commissary department in time of war. With deficient food was accompanied the insufficient supply of common salt, as it was never thought necessary to let it be furnished to the system otherwise than as a condiment.

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[1] Moleschott, *Phys. d. Nahr.*, p. 559.

This latter fact explains the remark of Becquerel and Rodier,[1] that the diminution in the quantity of common salt in the system was "manifestement due a l'absence de nourriture".

Lastly Aitken[2] relates that "when the heavy excise duty was imposed on salt, the poor in Ireland not being able to procure it as a condiment," much less as a food, "for their miserable fare, an epidemic fever appeared among them, for which common salt was accidentally discovered to act as a certain specific; it was therefore inferred, that the disease arose from a deficiency of it in the provisions".

When we remember in what close relation the potato, the predominant food in Ireland, stands to common salt, we can understand, why that country should be the constant home of typhus or famine fever, according to Prof. Virchow,[3] ever since 1708, about the time when the potato was introduced into Ireland. Prof. Virchow adds: that no country can bear comparison with Ireland in the many and severe epidemics, which have repeatedly decimated its inhabitants.

It was not hunger and starvation from the want of food alone, but it was disease and death through an insufficient supply of common salt; and the poor sufferers in their ignorance never gave it a thought to furnish their system with the preserver of health and life in any other way, than as a condiment to their potatoes. That the absence of salt in their body must have made the people more sensitive to their naturally moist climate, we would judge from what we have ascertained about the effect of water on the system, when this latter is deficient of sodium-chloride.

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[1] Becquerel and Rodier, p. 66.

[2] Dr. T. J. Aitken, *Elements of Physiology*, London, 1838, p. 159.

[3] Virchow, *Hunger Typhus*, Berlin, 1868, p. 10.

When counting the sufferings of millions of human beings and the enormous destruction of human life by disease during the present century alone in camp fevers of the Napoleonic wars, the Crimean war, and the many epidemics of famine fevers, it presents a sad picture.

Truly man's ignorance has demanded a far heavier tribute, than ever his murderous contests and his fiercest wars have done.

In an appendix I propose to make some remarks and reflections upon the illness of the Prince of Wales in 1871-2, since the incidents, connected with it, illustrate the position of the medical profession in relation to the treatment of the disease at that time, "when the proved, known, simple and adequate powers of medicine have been employed . . . *with the certainty and regularity of effect to which medicine in this respect has now attained*".

I will defer any comments on this claim to perfection, as I revert to it in the appendix. It is ruefully answered by the several epidemics of typhoid, which we have experienced since it was written; and the unfounded nature of the boast is shown by the numerous suggestions of new remedies, amongst them the latest "therapeutic achievement," the serum treatment, which has become fashionable and been tried with equivocal results.

We must from this infer, that all previous means have proved unsatisfactory, and that all that medical men can do is, as already stated, to discover where water companies, sanitary engineers and builders have failed to fulfil in a proper manner the duties of their respective callings. The doctors seem more anxious to trace the birth and development of the bacillus outside the human body, than to discover how to protect the latter against the infection by making the system insusceptible.

The whole subject suggests *a historical parallel.*

When suspicion arose in Maidstone that the wells, from which the Farleigh water was drawn, were poisoned, and were thus considered as the cause of the infection, the Local Government Board sent a competent medical man to Maidstone to make a report. This was in September, 1897. And when the epidemic was at an end, that is, 31st January following, an inquiry was instituted into the cause of the outbreak.

What the ancient Hebrews did :—

2 Kings ii. 19-21 :—

"And the men of the city said unto Elisha, Behold, I pray thee, the situation of this city is pleasant, as my lord seeth ; but the water is naught and the ground barren.

"And he said, Bring me a new cruse, and put salt therein. And they brought it to him.

"And he went forth unto the spring of the waters and cast the salt in there, and said, Thus saith the Lord, *I have healed these waters ; there shall not be from thence any more death* or barren land."

It does not say whether the men of Jericho asked for an inquiry by their Local Government Board ?

As there was no Elisha in Maidstone to " heal " the Farleigh waters, the sufferers intend making a claim against—whom ? Why, of course, the water companies. But I have no doubt that the directors will bring forward the 92 per cent. of the inhabitants, who used the water, without suffering from typhoid fever.

In many parts of Germany, especially in Thüringia, whenever a well gave turbid water, the inhabitants threw a few pounds of common salt into it, with the idea of purifying it. Schleiden, who reports this (p. 85), adds, " I cannot see upon which law of Nature this custom is based " ; and ascribes it to a traditional belief, descended from above biblical story.

I should think, however, that the tendency of common salt to combine or attach itself to organic matter (without entering into a chemical combination) and thus prevent fermentation and putrefaction, may have something to do with it.

The time may come, when the remedy, applied by the inhabitants of Jericho, will find an imitation by people, who look with contempt on this ancient sanitary custom, fancying themselves secure in the consciousness of having a government board and medical inspectors to ferret out organic impurities in well water, although impotent to stop the evil results by " inspecting and reporting ".

Above all this reporting, investigating and inquiring, there remains the incontestable fact that the treatment of typhoid fever and its prevention by an individual immunity, is as much, an unsolved question as it was at the time, when Sir John Forbes made his candid confession ; and again I declare that medical men are not justified to slight the suggestion, that deficiency of common salt in the human body is the cause of a predisposition for the various fevers ; and that they cannot conscientiously oppose any practical trial for deciding this question, without laying themselves open to a serious charge.

CHAPTER XL.

THE PLAGUE.

THE mere mention of this word develops in our mind the horrors of the most fatal disease, that can befall mankind.

The plague may be considered as a putrid typhus fever, with its infectious character and all its symptoms intensified.

"There are the usual prodromal phenomena of lassitude, rigor, nausea, headache and vertigo; oppression about the præcordia, anxiety and restlessness, with a heavy stupid expression of countenance, and a muddy or suffused state of the eyes. Then follow heat of the skin and great thirst, frequent vomiting, a coated tongue and fetid breath; a rapid, weak or irregular pulse, prostration, with perhaps tendency to syncope . . . the stools are generally dark and very offensive. The matter vomited is sometimes nearly black; and the urine, which is often very scanty and in bad cases almost suppressed, is occasionally sanguinolent. Hæmorrhage from the mouth, stomach and bowels, or from the respiratory passages, is not an unfrequent accompaniment.

". . . The necroscopic appearances . . . showed among other indications that all the parenchymatous viscera were loaded *with fluid dark blood*, and were generally much more *lax and softened in texture* than in health.

"The blood, whether drawn during life, or observed after death, has generally been found to be darker and more fluid than in health . . . the clod being loose and pliable . . . while the serum is often excessive in quantity and occasionally more or less sanguinolent."[1]

In fact the disease is a complete decomposition, we might almost say, putrefaction of the living body.

Sydenham tells us that "in the infancy of the plague" (in 1665) "scarce a day passed but some of those, who were attacked, died suddenly in the streets without having had any previous sickness".

These phenomena have all been observed in cholera, as also the absence of all protection after convalescence against a second attack (see my *Natural Immunity against Cholera*). From this we must conclude, that the plague is principally a disease of the blood; and, as in the case of cholera, we are justified in assuming that sodium-chloride will influence this disease equally favourably, as it was found to influence the former.

We need but look down the list of symptoms: the dark fluid blood; the transfusion of dark-coloured serum into the tissues; the appearance of blood in the urine, with other morbid phenomena, which indicate the destruction of the blood corpuscles; the proportionate increase of serum, showing a retarded formation of red corpuscles; the swollen lymphatic glands; the fetid breath; the offensive stools; in fact the whole morbid state of the system, bordering on a general dissolution, all point to a want of common salt in the organism.

And Dr. Milroy, from whose dissertation I have taken the above citations, honestly admits, under the head of

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[1] Dr. Gavin Milroy, in Reynolds' *System of Medicine*, i., pp. 322-327.

"Curative Treatment," that, "there is little on this head in medical writings at all satisfactory or encouraging in respect of the recovery of the sick, but much that is admonitory as to the baneful effects of an overactive and meddlesome medication. . . . The perusal of the recorded histories of cases of plague, as observed in Malta in 1813 and in Egypt in 1835, leaves the impression on the mind, that patients would have fared better had they been treated with light nourishing food and cordials, frequently administered, together with simple saline or acid medicines, and without active purgation, blood-letting and such energetic measures. The treatment, which is most suitable for ordinary typhus, is doubtless that which is applicable to the plague."

The "saline medicine," above referred to, does, however, not include sodium-chloride, but is mostly a tartrate or citrate of potash—chiefly given with the intention of lowering the fever. What, from our past inquiry we should recommend in a saline draught would be of course common salt, with the object of saving those blood corpuscles which are not already destroyed, of protecting the white corpuscles and the serum, and of inciting the liver, the kidneys, and—through the restored blood—the heart and lungs to a normal activity, as pointed out in previous parts of our discourse.

And applied in the early period of the attack, it would promise undoubtedly good results, in checking the progress of the disease, if it were given—*not as a specific in a single dose*, but at repeated frequent intervals, for the purpose of thoroughly permeating the system with it as a necessary constituent for the life and functions of the organism. I need but revert to the experience obtained in the case of cholera.

In February and March, 1897, I appealed to the Governor of Bombay—first by telegram and soon after by letter—for a trial of sodium-chloride as a prophylactic. I called attention in my letter to the fact, that in case of the bubonic plague, as in all other infectious diseases, the absorption into, and the mere presence of the morbid poison in the human body does not always cause an attack of the malady, much less kill. According to the Bombay statistics, one out of every four or five of those affected recovers ; and how many there are who have absorbed the disease germ and have remained uninfluenced by it, or only suffered from a slight indisposition, can only be conjectured. I called attention to Dr. Hawkins' observations in the case of Orenburg ; as also to Mr. Hermann's opinion about the cholera in Moscow (see *ante*).

And this assumption of an immunity is supported by the many instances of recovery after only a slight attack of the disorder.

Such difference in the susceptibility for the disease is constantly met with ; and that the plague makes no exception, is borne out by Sir Arthur Brooks Faulkner in his treatise on the plague.

He states (p. 181) : "Contagion is (most fortunately) not governed by a necessity of exerting its influence upon all individuals alike who come in contact with the subjects of contamination. This would be contrary to experience, *not only in regard to the plague*, *but to every other disease* which is admitted to owe its propagation to this cause. We do not, in fact, know in any contagious disease what it is that constitutes the susceptibility of the human subject, etc."

"The many instances which occurred during the plague"—at Malta—"of whole families escaping the contamination after having lived long in the most intimate communication with the infected, prove to what a great extent non-susceptibility may exist."

With regard to the assumption, that dirt and dirty habits are predisposing causes of an attack of plague, Sir Arthur Brooks Faulkner relates in his work (p. 190): "Several cases were known to me of individuals, labouring under the greatest violence of the disorder, being taken from the very bosom of their families, without communicating to them any injury—children from their parents, and husbands from their wives. Yet these families had used no kind of precaution whatever; indeed, in most instances, not so much as an attention to common cleanliness. . . . My own calesseman and two of his children died of the plague, but his wife was never infected, nor his brother-in-law, though constantly attending on the family in their illness. These people were also very neglectful of personal cleanliness, and used no kind of precaution whatever."

It is evident from this account of Sir Arthur's experience, that the chief factor for the development of plague is—as in other diseases—an individual susceptibility; that hence a protection is found against the disease in a natural immunity.

This once admitted—in fact it would be in violence of all truth and reason not to do so—one cannot escape the further admission, that for stamping out the disease our energies should be directed towards the discovery of the cause of this immunity, and then apply the necessary remedy to impart that immunity to the people in all regions where the disorder begins to show itself.

And it must be evident, without much demonstration on my part, that the cause of a natural immunity against even so mortal a disease as the plague, must be looked for in some simple factor, since such marked difference in susceptibility, as pointed out by Sir A. B. Faulkner, can actually exist in the same house, the same family, where parents and children live in the same surroundings, under the same mode of life, enjoying similar food, show equal disregard for cleanliness, and furthermore with—we may assume—similarity of constitution.

And experience in, and observation upon, the question of either the permanence or mutability of such predisposition, would also point to some simple factor, which can influence the human organism for or against the disease.

All these points considered then, it would be rash, nay, in face of the great and universal benefit at stake, it would be criminal, to neglect, and much more so, to oppose the opportunity of giving a thorough and honest trial to so promising a prophylactic as the supply of common salt to the human system.

The prisons and the barracks would offer the most favourable opportunity for such an experiment, which could be arranged and superintended by conscientious and competent persons, free from medical bias and from professional conceit.

I have not learnt the fate of my appeal (sent as stated above in March, 1897), but there can be no question of its safe arrival. Perhaps it was referred to some "Surgeon-Field-Marshal" who would consider it *infra dignitatem* to notice so common a subject as common salt. Meantime Bombay has had a recrudescence of the disease, which has struck down for weeks together about two hundred human beings per day.

General Gatacre's "Report on the Bubonic Plague in Bombay, chapter iii., gives a very excellent summary of the medical aspect of plague, derived from the views expressed by the medical officers working under the committee".[1]

And what is the upshot of these medical views?

"Reviewing opinions generally, the following is given as a rational classification of forms of plague:—

"1st—With enlarged glands (gravity according to symptoms and severity of attack), femoral, inguinal, axillary, cervical, tonsillar" (evidently highly scientific sub-divisions).

"2nd—Without enlarged glands (almost always fatal), septicæmic, pneumonic, mesenteric, enteric or gastro-intestinal, nephritic, cerebral."

"The signs and symptoms of these various forms are then given, followed by a section on *Ready Method of Diagnosing Plague*." (On this, according to "medical opinions," everything depends. But does it? Let us see what follows.)

With regard to treatment the report states: "It is difficult to recommend any particular line of treatment with confidence, for it is often seen, that a plan of treatment which succeeds" (?) "in one case, totally fails in another".

Then what in the name of common-sense is the use of the above pseudo-scientific classification? Is it not puerile?

Why not candidly confess, that medical science and art is helpless in either the cure or the prevention of plague; and that this meaningless classification is practically valueless?

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[1] *The Lancet*, 22nd Jan., 1898, p. 250.

Has not all and every treatment—even by sanitary and hygienic means, much more so by clinical therapeutics—proved to be incompetent by the stern and damning fact of the great mortality during the second Bombay outbreak?

Says *The Lancet*: "Considerable interest attaches to the reports of M. Haffkine and Dr. Yerson's method of treatment, neither of which, however, was attended with the success which had been hoped for". This refers to the serum treatment, about which we shall learn more immediately (see also pp. 242 and 331-2).

Altogether this is a sad picture, which should bring sorrow into the ranks of the profession, and leave among its members very little cheerfulness from the large store, which Sir James Crichton Browne has claimed for them.[1]

But with regard to the practical application of the prophylactic means, for which I contend, should its efficacy be ultimately established, which I hope and do not doubt—what a remorse, what a feeling of guilt, bordering on that as of manslaughter, must take possession of the man, who in his conceit and pseudo-wisdom has vetoed its employment.

But there is no legal court before which he might be arraigned, except human conscience.

[1] *The Spectator*, 9th Oct., 1897, p. 484.

CHAPTER XLI.

SERUM TREATMENT (OR THERAPEUTICS).

ALTHOUGH this subject has *apparently* no *direct* connection with common salt, yet its unquestionably doubtful results (not only in the case of the plague as just mentioned, but also in other diseases) or the little good it apparently has done will necessitate us to pay it closer attention, when we shall discover that sodium-chloride may have had the greater share in the benefit ascribed to the serum.

Practical medicine, as the art of curing disease, has so little which it can present as positive facts, that any method, any system, any drug, which only *promises* some good results, is taken up with eager pursuit ; and a great deal of questionable labour and energy is bestowed upon minor points, before the fundamental principle is incontestably established.[1]

" The cause, of so tenaciously maintaining conclusions upon false premises, is accounted for not only by the precedence of the investigators in the predominating doctrine, but also and chiefly by the enthusiasm and want of critical inquiry on the part of medical men," says Dr. Gottstein in his treatise on serum treatment.[2]

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[1] The enthusiast who cannot see beyond the " length of his nose," may carry its application to the cure of kleptomania, false swearing, swagger and other psychological aberrations ; and one son of Æsculapius has discovered the microbe of death and so holds out to us eternal life.

[2] Dr. A. Gottstein, *Diphtherie-Serum*, Berlin, 1894, p. 30.

In the case of tuberculosis it ended in sad and grievous disappointment to many sufferers, as it utterly failed to fulfil the ill-considered promises of the originator and his disciples.

In cholera it was based upon a complete misconception of the nature of the disease, and I cannot resist the temptation of repeating, what I wrote on a former occasion in reference to an article by Dr. Haffkine on "Vaccination against Cholera," which appeared in *The Fortnightly Review* of March, 1893.

"One might pale before a science, which proposes to apply such means to a hundred persons that three of them[1] may be saved from an attack of the disease and half of these from an untimely death; especially so since a second inoculation is deemed necessary to deprive the first of its life-endangering character."

It cannot surprise us to read in *The Calcutta Journal of Medicine* for September-October, 1896, that: "Dr. Sircar gives a searching examination of the results reported from Dr. Haffkine's inoculation for cholera, and that he comes to the conclusion, that the method is useless and dangerous".[2]

So also in the case of the plague in India. Medical papers have from time to time given encouraging reports of the serum treatment, in which no doubt "the wish was father to the thought". But already in the early part of 1897, during the first outbreak at Bombay, *The Lancet* pronounced the outcome of Dr. Haffkine's serum injection as a failure, and only recently the Medical Commission, sent by the Russian Government, reported that both Dr.

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[1] This number refers to the percentage of people that have a predisposition for cholera.

[2] *Homœopathic Journal*, Oct., 1897, p. 394.

Haffkine and Dr. Yerson had failed in their attempt to cure the disease by the serum treatment.[1]

And the enthusiasm, which the treatment of diphtheria by the injection of "antitoxin" occasioned during the last few years, should, one would think, have led to something definite and conclusive by this time; but it seems, that the prevention and the cure of the disease have been advanced in no very marked degree, as we shall see later on.

It is not necessary to enter fully into the historical development of the serum treatment, although it would enable us to estimate its rationale more correctly, than by the few facts and citations which I propose to bring forward; it must suffice for our purpose to give a cursory description of the process as employed at present, and the idea which induced its adoption.

It could not possibly escape even the superficially observant pathologist, that many human beings naturally possess the power of resisting the causative agent of the various diseases, and that others seem to be protected against a second attack after having suffered the first. Furthermore it was noticed that the immunity was acquired after an attack of even a light form of the disorder, according to the natural susceptibility for it. This led to the artificial communication of the disease to healthy persons to induce a mild attack, and so protect them against that particular malady; which protection in the case of variola was assumed to last for the whole life—a most unfounded assumption, as is now admitted.

In the case of small-pox it requires the introduction under the skin of but a very minute portion of diseased

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[1] *The Lancet* during the latter part of 1897. See also *The English Mechanic* of 3rd Dec., 1897, p. 361.

"lymph" to affect the whole body, often with very marked symptoms; but in diphtheria, typhoid, tuberculosis and several other disorders, the procedure has taken the character of injecting a smaller or larger (in some cases a suspiciously large) quantity of serum into the circulation. This "curative" serum is prepared in the following manner:—

It is assumed that a micro-organism enters the system and causes the disease. I say, "it is assumed," because weighty opinions have been raised against this assertion by stating, that the bacillus may be the concomitant phenomenon, if not the product of the disease, instead of the causative agent.[1]

It is further assumed, that the immune body produces a poison or a substance which is antagonistic to the bacillus, and to obtain the means for inciting this natural reaction of the system and impart the same immunity artificially, the specific pathogenic germ is introduced—in the first instance—into the body of a (sometimes not very healthy) horse; first in minute quantity and weakened by dilution, and then, after intervals, in not only increased doses, but also of greater virulence. The horse has, no doubt, to pass through an attack of the disease more or less severe, but on recovery it is bled; the blood is freed from the red corpuscles and from the fibrin, when the serum remains ready for injection into the body of human beings.

This serum, it is contended, contains the antitoxin, and when injected into the organism of a sufferer from one of the above-named ailments in repeated small doses, it is said to counteract the pathogenic effect of the bacillus or its toxin, but leaves the human body unaffected.

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[1] Drs. Gottstein, Schleich, Kreidemann, Windrath, and numerous writers in *Hygieia* and other publications.

Of course it is necessary to determine whether the symptoms, against which the injection is to be applied, are those of diphtheria, or scarlet fever, or croup, or perhaps only a slight affection of the throat, before the curative serum can be injected. In other words, the disease must be sufficiently developed, must show marked morbid symptoms, before the doctor can apply his remedy; because the diphtheria antitoxin cures only diphtheria and no other malady; and the early symptoms give no reliable indication of the true character of the coming disorder. Until such a time, *i.e.*, before the doctor can make a safe diagnosis, he stands irresolute at the patient's side, unless he prescribes an expectant medicine—a little coloured sugar-water—to appease the anxiety of parents and friends.

To guard against the imputation of having ignored the advances which have been made in the system or the method employed in the serum treatment, we will consult the inventor or originator of it—Dr. Behring—who has lectured on the subject quite recently (27th January, 1898) at the University of Marburg, as reported in the principal medical journal of Berlin.[1]

First we must notice, what he states about the general object of the treatment, the fundamental principle, *viz.*, the destruction and the neutralisation of the diphtheria-bacillus; he says:—

"It may be considered as an established law that the living cells of the human and of the animal body are a great deal more sensitive to the means of disinfection than are all the known bacteria ; so that, before the bacteria can be killed or be prevented from multiplying in the blood, the infected (*i.e.*, the human) body will be killed ".

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[1] *Deutsche Medizinische Wochenschrift*, 27th Jan., 1898; also *Umschau*, 19th Feb., 1898, pp. 137 to 140.

To prevent this . . . " *the bacterium poison is first made harmless* . . . by the preparation of the curative serum. The diphtheria-bacilli *grow unimpeded* in this diphtheria curative serum, and if nevertheless they become perfectly harmless, it is owing solely and chiefly to the fact, that by being deprived of their poisonous nature, they have been robbed of the weapon which made them dangerous."

One is involuntarily reminded of what Kühne says in relation to the use of drugs against fever: that they "were tried and found satisfactory until it was discovered later on, that their efficacy could be depended upon only when they acted as poisons" (toxins), "and that, when administered in smaller doses, which showed no undesirable effects, they were useless ".[1]

So it will most probably prove with this vaunted antitoxin. We cannot so readily accept this metaphor (robbed of the weapon) as a valid explanation, and must listen with surprise at the following sentences in his (Prof. Behring's) concluding remarks :—

"The application of this curative principle, as exemplified in the serum treatment, *is always accompanied with some danger*, since *it requires a certain intensity in the poison* to excite the cells and the organs to a reaction against it, and thus to cause the formation of the antitoxin, which neutralises the poison. And the danger is especially great when the body shows great irritability, as evidenced in high temperature.

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[1] Dr. H. Kühne, *Die Bedeutung des Anpassungs-gesetzes für die Therapie*, Leipzig, 1878, p. 8.

"Whoever would treat all attacks of an infectious disease on the isopathic principle of cure, even the acute, in which the great danger lies in too great an intoxication of the cells—he would experience what often can be demonstrated in experiments upon animals: he would heighten the disease, and hasten the fatal issue."

Certainly; such, almost contradictory, demonstration cannot inspire confidence and hope.

Another aspect will now attract our attention: Prof. Dr. Hans Buchner of Munich has discovered, that the blood serum of a healthy human being possesses the same power against the diphtheria-bacillus as is claimed for the artificially prepared serum. This should not surprise us, from what we have learnt above, about the presence of the bacillus, often in considerable quantity, in the throat and other parts of the body of *healthy* human beings.

The same experimenter shows that this antitoxin, in the prepared serum, does not overpower the bacillus, nor that it destroys the poison; and that, when the toxin and the antitoxin are mixed and administered to certain animals, the poison exerts its full power and kills the animal.[1]

"A singular peculiarity," says Dr. Max Gruber, "of the immunity, produced by this protective serum, is its rapid development, and its *equally rapid disappearance.*"

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[1] Prof. Dr. Max Gruber, *Ueber Schutz und Heilserum*, Wien, 1895, p. 21. This calm and well-considered lecture before an "Association for Promoting Scientific Knowledge"—consisting therefore of non-professional listeners—should be read and digested by every one—even by professional serum injectors—who wishes to be well informed, or who deems himself competent to give an opinion on the subject of serum treatment. This remark applies equally, if not more so, to Dr. C. L. Schlrich's *Immunität*, Berlin, 1894.

Dr. Gruber further informs us (p. 24) that, "there is no direct connection between immunity and the protective serum. In a natural immunity—antitoxin cannot be found in the body. . . . If on the one hand we meet with immunity without antitoxin—we on the other must experience, that by careless or too frequent or overdosed injections, these highly immunised animals show serious indication of poisoning, and a supersensitiveness for the original toxin."

And he arrives at the conclusion that, "*the formation of antitoxin in diphtheria and other diseases is but an accompanying phenomenon of the acquired immunity, and not the essential part of the process*" (p. 25).

The whole subject is still surrounded by much mystery, and is far from having arrived at a stage to deserve the name of an established fact. Besides, notwithstanding the assurances of medical men about the harmlessness of the serum injection, it is authenticated that cases of serious illness have been occasioned by it. Already in 1894 voices were raised against the serum injection as dangerous. Dr. Hansemann, the assistant to Prof. Virchow, in a paper on the serum treatment before the Berlin Medical Society, called attention to it, "that the serum could not be regarded as harmless. The well-known facts, that it caused pain in the joints, fever, etc., were represented as trivial matters, because the cure took place at once. More serious cases were those, where diseases of the kidneys set in. In the Berlin Charité Hospital a child died of diphtheria after the serum injection, and it was found that the kidneys were changed in such a manner as never happens in scarlet fever or diphtheria."[1]

A most distressing case was the death of the son of Dr. Langerhans. The father "allowed himself to be persuaded to inject his little boy, aged one year and nine months, with antitoxin as a *precautionary measure.* A few minutes after the operation, which the unfortunate father himself performed, the child, who was before in blooming health, was dead. . . . No positive diagnosis, however, of the cause of death was obtained, though it was discovered, that the organs of the child were completely healthy."

The Times' correspondent, who reports the above (13th April, 1896), adds: "I may mention here, that at the Medical Congress held recently at Wiesbaden, voices were not wanting, which condemned the antitoxin treatment of diphtheria, introduced by Dr. Behring, as untrustworthy and dangerous".

A Berlin doctor calls attention to an article by the well-known Prof. Liebreich of the Berlin University.[2] He writes: "We find here a series of serious illnesses which appeared after the use of the serum and which often lasted weeks and months. The best known of them is the one, which Dr. Pistor of Berlin made public, and which befell his own seven years old daughter" . . . who was in consequence "laid up for fully three months. The Frenchman Variot of Paris, who has perhaps the greatest experience, and who advocates the use of serum for diphtheria, expressly warns the profession against its use for the purpose of conferring immunity. Not only have serious illnesses appeared after injections with the serum, but in some cases perfectly healthy children have died. These experiences should suffice to refute the assertions, spread by persons interested in its success, that the use of the serum is not dangerous. . . . What has been published on the subject shows not only, that the treatment of diphtheria with serum is dangerous, but that the idea of immunisation is a false one."

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[1] *Daily News*, 30th Nov., 1894. (Taken from the *Deutsche Medizinische Wochenschrift.*)

[2] *Daily News*, 11th April, 1896.

This was written in April, 1896.

The dangerous character of the process must have been uppermost in the mind of Dr. G. Sims Woodhead (Director of the Research Laboratories of the Royal College of Physicians and Surgeons, hence the highest authority on the subject in the United Kingdom), when, in his lecture at the Examination Hall, Victoria Embankment, on 7th Dec., 1894, he stated that, "the antitoxin serum is a direct therapeutic agent, and *need only be used in patients actually suffering from the disease*, *where benefit may be expected* to accrue," and at the end of his lecture he refers "*to those on whose shoulders rests the serious responsibility of diagnosis*".

Hence the serum injection gives no immunity; it can be employed only against a specific malady as a specific therapeutic remedy, and this only when the disease has been correctly diagnosed. And this latter is uncertain and doubtful, until the symptoms have fully developed, by which time these latter have probably assumed already so serious a character, as to be beyond the influence of any simple therapeutic remedy, that would have been of a preventive or curative benefit at an earlier period of the attack.

The report of the medical superintendents of the Metropolitan Asylums Board upon the use of antitoxin serum in the treatment of diphtheria during the year 1895, closes with the following expression of opinion, to which all the medical officers of the hospitals subscribe their names: "*We are further of opinion that in anti-toxin serum we possess a remedy of distinctly greater value in the treatment of diphtheria, than any other with which we are acquainted*".[1]

Fiat Medicina—pereat . . .? . . . Quackery . . . ?

RESULTS OF THE SERUM TREATMENT.

It is only just that we should now direct attention to the practical achievements of this latest "remedy of greatest value," to ascertain how these bear out above eulogium for or against the theory. We shall find, however, that, as in so many other instances, the statistics are very deceptive and very elastic; they can be made to prove anything.

Dr. Gottstein, in his sober and logical treatise, *Serum Therapeutics and Cure Statistics*, gives the percentage of mortality of 1886 as 23·8; of 1887 as 25·6 as a minimum during a number of years; of 1893 as 38; and of 1894 (the year which should show the first effect of the serum treatment) as 34·2 per cent. (nine months only).

These figures show unquestionably that other factors are at work, and they do not support the efficacy of the serum injection.

The Lancet of 8th January, 1898, contains a report of a criticism of the serum treatment by Prof. Purjesz in a "brilliant discourse before the Buda-Pest Medical

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[1] *Daily Chronicle*, 11th April, 1896.

Society, in which he showed that the improvement claimed for the serum treatment was apparent only; that other important factors—such as the mildness of the epidemic, anxiety of parents to have even the mildest cases treated with serum—were to be considered. Prof. Purjesz, in conclusion, adduced some other striking arguments, and repeated his conviction, that the alleged usefulness of the serum treatment still remains to be proved."

Of London statistics I shall refer only to two or three sources of information, quite sufficient to indicate the "progress" made by this new system. In the above-mentioned report to the Asylums Board, it is stated, that the *average reduction* in the mortality during the year 1895 was 7·1 per cent. This is not a grand achievement; and this will come out at a still lower figure, according to Mr. Boulger's systematic investigation, if taken into account.[1] In fact, his figures are most damaging; space prevents me from reproducing them here, which they deserve *in extenso*, to carry weight and conviction with them. I am not acquainted with the reply given to his challenge, or whether it has been treated with silence.

The alarm raised by Mr. W. J. T. Barker, D.Ph. Camb., in *The Times* of 9th Oct., 1897, is fully confirmed by an analysis of deaths from diphtheria during that year, as given in *The Lancet* of 22nd Jan., 1898, according to which there were 2262 deaths from that disease at a mortality of 17·7 per cent. This low rate of mortality can be fully accounted for by the fluctuations which the disease is subject to in a cycle of years, and cannot be accepted as the special outcome of the serum treatment; but which, after all, does not show a great success.

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[1] *Daily News*, 17th April, 1896.

Granted, however, that the serum treatment has influenced the rate of mortality, it can be accounted for in other ways than by giving credit to the antitoxin.

A writer in *Hygieia* pointed out, that with the application of the serum injection (or squirtery, as he termed it) there ceased the most destructive treatment with drugs, which to a very great extent paralysed the recuperative powers of the system and caused as many, if not more deaths than the disease itself. Next, not only the parents and friends, attracted by the dazzling promise of a certain cure, brought all cases, whether diphtheria or only sore throat, for the serum injection. But also the desire to appear before the world with some definite achievement caused many cases to be admitted as diphtheritic, which were not so, and which in former times would have been excluded.

And, lastly, there is Prof. Buchner's discovery, that *the bacteria-killing serum loses its effect when it is deprived of sodium-chloride.*[1]

What more direct evidence is required, that the good effect, claimed for the antitoxin, can be ascribed to common salt, than this result of Buchner's researches?

To sum up: whether it is intended against the plague, or cholera, or typhoid, or diphtheria, or for any other therapeutic object—the mere fact that the serum is to be injected into the human organism demands absolutely *that it contain sodium-chloride*, without which it will be harmful. There is besides no other substance which can replace the salt ; and if any benefit is derived from the serum injection, we are justified in claiming this in greater part, if not all, for common salt.

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[1] Prof. Dr. Emmerich und Prof. Dr. Tsuboi, *Die Natur der Schutz und Heil-substanz des Blutes*, Wiesbaden, 1892, p. 10.

We may well exclaim with the above writer in *Hygieia* :—

O serum, serum, serum ;
O quæ mutatio rerum !

CHAPTER XLII.

DIPHTHERIA.

AMONG the many diseases which attack the human being during the period of adolescence, none is more dreaded than diphtheria.

The very mention of the name sends a thrill of fear and horror into the minds of parents, and not without reason. How many a household has not been, not only decimated, but literally emptied of its young inmates, one after the other, during a few days; and often the mother, borne down by grief and care, with a broken heart—a sacrifice to her maternal devotion—succumbs also, and joins her children in the grave. Looking down the list of deaths in the morning paper, who has not frequently noticed the announcement of three or four members of one family having fallen victims to this insidious scourge, which mocks the efforts of medical science and art in the attempt to master it?

Let us endeavour to learn in what relation common salt stands to this malady; and I believe that our attempt will meet with most gratifying results.

The attack of the disease commences with a general feeling of indisposition, great prostration, headache, want of appetite, a certain stiffness in the neck and sore throat. All these symptoms may be considered as indications of a severe cold, and may cause no alarm, unless discovered with the knowledge of an existing or preceding case of the disorder in the same family or the same house. The more morbid symptoms, in the course of a few days reveal, however, the true nature of the ailment, as more characteristic affections become manifest. The glands of the throat begin to swell, and above all an exudation of lymph (*i.e.*, blood plasma) in the throat makes its appearance.

This exudation spreads in various directions; from the back of the mouth up into the nasal region and down into the larynx, and even into the trachea. It forms a more or less tough membrane, and its growth and extent into and over the larynx threatens the life of the patient through suffocation.

It is needless for us to enter upon the many phenomena accompanying the attack; or to refer to the various sequelæ, which make their appearance in convalescence. We will notice the general symptoms of the malady, and then consider that specific phenomenon, which gives the disease its name: the formation of the membrane in the throat.

In this, as in all other infectious diseases, the effects, resulting from an invasion of the system by the morbid germ, vary very greatly in different persons.

"Constitutional predisposition has a great influence in increasing the liability of families and individuals to receive" (develop?) "the disease; of two families residing in the same house, several members of the one have suffered, while all of the other have escaped; a difference of susceptibility is also observed in members of the same family, and this not always in favour of the seemingly robust."[1]

In fact the discoverer of the diphtheria-bacillus, Prof.

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[1] Reynolds' *Syst. of Med.*, i., p. 381.

Löffler, declared,[1] that "the bacillus could be present in the nose or larynx of healthy persons, without producing the symptoms of the disease.

"After cure, as a rule, the bacillus disappeared with the local symptoms, or shortly after; but *sometimes remained for weeks, even for months, alive and virulent in the throat or larynx.*"

We can, however, not accept this latter phenomenon as indicating, that those who have passed safely through the attack, have thereby acquired an immúnity.

"That the same person may repeatedly suffer from the slighter forms of the malady, and that some do so upon the slightest exposure, is frequently observed."

Throughout all these inquiries, what must most forcibly impress itself upon our mind is the fact, that the personal predisposition is the first and chief factor in causing the disease, and no doubt can exist, that this susceptibility is dependent upon some simple, yet important difference in the mode of life or the food, since members of the same family, living in the same surroundings, partaking of the same kind of nourishment, and presumably having inherited similar constitutions, yet are differently affected.

Dr. Edward Seaton, Professor of Hygiene at St. Thomas's Hospital, London, expressed the opinion[2] that "this peculiarity in the distribution of the disease seemed to favour the view, that diphtheria was mainly dependent on the habits of the population rather than on telluric conditions". This of course supports the view, that individual susceptibility is the primary factor in the attack.

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[1] *The Times*, "Report of the International Congress at Buda-Pest," 4th Sept., 1894.

[2] *Ibid.*

When unable to give a reasonable, *i.e.*, scientific interpretation of the phenomena surrounding infectious diseases generally, we find the ordinary "legitimate doctor" always ready with his judgment, "dirt disease".

But that dirt, in the usual acceptation of the term, is not a direct exciting cause in the etiology of this class of disease, is shown by Dr. Thorne Thorne, whose remarks, reproduced in *The Times* (10th Nov., 1887), are, ". . . all which cleanliness could effect, seemed to be powerless against other epidemics, such as scarlet fever, *diphtheria*, measles and whooping-cough, which visited the clean and the unclean equally".

It will be useless to enumerate the drugs which have been recommended and tried by orthodox medicine; a few only may be mentioned here, ". . . such saline medicines as exert a slight action on the skin, and on the kidneys, or both. Acetate of ammonia and citrate of potash are well suited."

Besides these, calomel and jalap, calomel and colocynth, sometimes to be followed by a saline aperient, *e.g.*, sulphate of magnesia, copaiba and cubebs, and many others.[1]

But all of no avail. It may truly be said, what Mephistopheles told the student:—

> Ihr durch-studirt die gross' und kleine Welt
> Um es am Ende geh'n zu lassen
> Wie's Gott gefällt.

The disease takes its course uninfluenced by any of the vaunted medicines; and ". . . in more than half the fatal cases of diphtheria, death results direct from diseases of the larynx," *i.e.*, from suffocation through the closing of the air-passage by the membranous growth. "Tracheotomy undoubtedly saves a small proportion of cases."[1]

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[1] Aitkin, *Science and Practice of Medicine*, London, 1868, i., pp. 575-576.

The mortality varies from about 15 to 50 per cent. of affected cases, but the statistics are unreliable. Dr. Hermann Biggs stated at the Congress of Public Health in London[2] "that something like one-third of the cases reported (to the health department of New York City), on bedside evidence, to be diphtheria, are not so; and, on the other hand, that many cases of sore throat, apparently of the mildest type, are truly diphtheritic, and are capable of disseminating the disease in all its intensity".

But why all this outcry about diphtheria or no diphtheria, about a mild, or a semi-malignant, or a highly malignant attack? Is not the object to cure? and are there special remedies for each severity of the disease, from a simple sore throat to the most virulent form through, perhaps, thirty or forty gradations? Is not this a playing with human life, by concentrating all energies on merely ascertaining and naming the violence of the attack?

"Out of 405 cases of true diphtheria, subjected to *repeated bacteriological examinations, performed at short intervals*" (to save the patient? or to get a clue to the drug, indicated in the medical ready-reckoner?) "during the course of the disease and during convalescence, the bacillus disappeared within three days after the complete separation of the false membrane in 245 cases."

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[1] Aitkin, i., pp. 572 and 577.

[2] *The Times*, 18th Sept., 1894 (letter from Lennox Browne).

Yes; at its own pleasure, and not as the result of the treatment. "It persisted for seven days in 103 cases, for twelve days in thirty-four cases, for fifteen days in sixteen cases," etc.

Of what practical use are all these observations? *We must pity the poor patients.*

Mr. Lennox Browne continues: "I have no desire to do other than advocate for yet more . . . ? . . . *rigid sanitary reforms*".

Again dealing with drains and cesspools—but not with the question of vanquishing the susceptibility of the human body.

If we now consider the various general symptoms (as distinct from that specific tendency in this disease—the formation of a membranous growth in the air-passages—about which more immediately), we can understand, from what we have learnt in previous parts of our inquiry, how a deficiency of common salt in the system can assist in the production of many of the most important morbid phenomena met with.

Loss of nervous energy, a rapid and feeble or an irregular pulse, may both result from want of oxygen in the blood, and this in turn be caused by deficient sodium-chloride. Hæmorrhages and albuminuria, as also various lesions, which occur at times, may be the outcome of a watery state of the blood, *i.e.*, low concentration of common salt.

But of far greater importance shall we find sodium-chloride, when we inquire into the nature of the exudation of lymph, and the formation of the membrane, which is in the majority of cases the immediate cause of death through suffocation.

Here we must notice first, that "the disease is marked . . . by a varying amount of congestive action . . . in various parts of the mucous surfaces, as well as of that of the fauces and first air-passages, where the speciality of the diseased action is most marked, and where it sometimes spends its whole violence.

"The local lesion peculiar to diphtheria is most readily induced in surfaces exposed to *the free access of air.* . . . It is there that it assumes its most characteristic development; there is a stasis" (stagnation) "of blood in the capillaries, *a destruction of the red blood corpuscles, and a formation of fibrin, as shown by the spontaneous coagulation of part of the exudation.*"[1]

If you remember what was stated in the preceding part of our discourse about the effect of common salt on the blood, it must, after reading the above, dawn upon your mind, that we are approaching a very important question about the relation of sodium-chloride to diphtheria.

We have already been informed that this coagulation —this formation of fibrin—is but one step in a gradual process of oxidation. "Albumen, while still in the blood, absorbs already oxygen. The substance, which in the act of coagulation, encloses the red corpuscles of the blood, and thus forms the clot, is nothing else than a higher oxide of albumen. It is called fibrin from the fact, that by whipping the blood with a switch, it separates from the blood in the form of fibres."[2]

This whipping is but the simplest way of bringing the albumen or the fibrin of the blood in contact with the oxygen of the atmosphere.

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[1] Dr. W. Squire, Reynolds' *System of Medicine*, i., p. 394.

[2] Prof. Jacob Moleschott, *Kreislauf des Lebens*, "Antwort auf Liebig's *Chemische Briefe*," Vierte Auflage, Mainz, 1863, p. 121.

In diphtheria the blood is in such an abnormal condition, that access of the air, *i.e.*, oxygen, causes the fibrin to coagulate; and this tendency is so great that during the height of the attack, if any part of the external skin is abraded and caused to bleed, the fibrin of the blood, having come in contact with the air, will coagulate.

We can now understand why the throat and the air-passages should be the seat of the disease in its most characteristic development; they are, of all mucous surfaces on which the blood plasma can exude, the most immediately exposed to the atmosphere.

Again we must ask: How can we account for the great difference in the degree in which the poison attacks different sufferers and leaves others unaffected? In one case we find the exudation soft and little adherent—easily coughed away; in another . . . "the false membrane cannot be detached without leaving a bleeding surface, which is rapidly covered with a new layer".[1]

And this membranous substance, when treated with various reagents and tested in sundry processes, "assumes entirely the character of pure fibrin".[2]

And what is there, as a normal ingredient in the healthy blood, which prevents this coagulation; checks it or controls it within normal limits? Answer:

COMMON SALT.

That this answer is borne out by reliable facts, in so far as practical trials of its application in cases of diphtheria can prove it, may now engage our attention.

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[1] Dr. Squire, Reynolds' *System of Medicine*, i., p. 395.

[2] *Ibid.*, p. 397.

It is not difficult to comprehend, that the external application of a corroding substance to the false membrane, with the object of removing it, can have no effect whatever; that hence, it is quite futile to paint the affected throat with any drug.

The membrane grows from the surface, whence the blood plasma exuded; and any attempt to loosen the morbid growth must proceed from the root of it—from the blood. What more natural than to supply sodium-chloride to the system and charge the blood with it to its maximum density. It can not only prevent the dissolution of the blood—restore it to an effective condition for relieving the heart as also the lungs—but it will prevent the further coagulation of the exuding plasma; will even *dissolve the coagulated fibrin, where it adheres to the tissues of the larynx*, etc., and thus cause a cessation of the formation of false membrane; *effect the loosening and separation of the already existing membrane and make its expectoration possible.*

You will, no doubt, ask, whether any practical experience has been gained in the use of sodium-chloride in the treatment of diphtheria; and there may probably lurk in your mind the further question, whether or not the treatment generally adopted by the profession is so unsatisfactory as to necessitate the employment of other or more effective means for preventing and curing the disease.

Every honest physician who does not attempt to overawe the non-professional questioner by a slip-shod logic and boastful assertions (in the style of J. C. B. in *Odium Medicum*), will candidly repeat what Sir John Forbes and Dr. Seaton have already told us, that medical art cannot influence the course of the disease, and that we must not assume that the knowledge of the preventive measures is in an advanced state.

The treatment of this, as of most other forms of disease, has been subject to constant changes, and the fashions that have been in vogue in therapeutics generally have extended also to diphtheria. It has been a constant "trying" with doubtful and often mistaken results; and at the present time the serum treatment, as already stated, holds dominion, at least among orthodox practitioners (see *ante*, p. 251).

It would be considered high treason were I to relate the success obtained in the treatment of diphtheria by hydropathists, since their method, however successful, is designated as quackery; although the same means are now employed by a great many physicians. I will therefore cite a medical authority, who holds the legal title of M.D., and to whose opinions, or to the results achieved by him, any professional opposition cannot be raised.

In a small pamphlet published in 1883, Dr. G. F. Wachsmuth[1] records his experience in the treatment of diphtheria after nearly twenty years' practice, and he states: that the results obtained, force him to the conclusion, that a rational method of exciting perspiration in the patient is the only system by which the disease can be checked in its development and the patient's life saved.

He has discarded the employment of all cauterising substances, such as hydrochloric acid, nitrate of silver, permanganate of potash and even carbolic acid, and merely keeps the diseased surfaces in the throat clean. To induce perspiration he never uses pilocarpin *because it weakens the system*; but he excites diaphoresis in wet sheets and blankets, followed by a refreshing ablution in cold water, *which strengthens the system and imparts to it the power to resist the attack;* and, whilst recommending scrupulous cleanliness, especially of the skin, he consoles the laity with the assurance that by the employment of above means, diphtheria can be successfully treated and need cause no fear.

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[1] Dr. G. F. Wachsmuth, *Diphtheritis*, Leipzig, 1883.

With the perspiration he combined in former years as a gargle, first lime water, and after a few days a solution of chlorate of potash, as also an internal administration of this potash salt in solution. In a footnote he warns, however, against its use, as *many children die from a dissolution of the blood* caused by the chlorate of potash.

After an interval of twelve years, Dr. Wachsmuth has published his further experience[1] in another treatise, in which he compares the result of his treatment with that of serum therapeutics.

Here we observe that he has also discarded the chlorate of potash and substituted *sodium-chloride, administered internally*, and that this, combined with the perspiration, produced by means of wet-sheet packings, enables him to show a better result than any other form of treatment.

He very properly remarks, that *the extraction of water from the system by perspiration increases the proportion of sodium-chloride in the blood*, and the loss of salt by the perspiration (which loss, however, is not very great), he replaces by a diet rich in common salt (salt herrings).

Without desiring to enter further into the theory of his treatment, he remarks, that it appears to him highly probable "that the *higher the percentage of common salt*

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[1] Dr. G. F. Wachsmuth, *Die Behandlung der Diphtherie in Ve zur Serum-therapie*, Berlin, 1895.

in the serum, the less favourable is the condition for the diphtheria-bacillus to exist and maintain itself".

Dr. Wachsmuth, however, does not seem to be aware of the real benefit which the supply of salt confers on the sufferer, or of the special function which it performs by preventing the formation of the diphtheritic membrane, as pointed out above.

"In the country," he continues, "I have often noticed the excellent effect produced by the drinking of salt herring liquor, which was given to the patients to drink, previous to my arrival. And in Berlin also it has happened several times, that I was called in to attest the health of children for readmission to school after they had passed through an attack of scarlatina-diphtheria without medical treatment. Upon my inquiry: 'What have you done?'. I received the reply: '*We gave the children salt-water to drink and made them gargle with it*'" (p. 5).

He again refers, in this second report, to the many sudden deaths caused by the large doses of chlorate of potash through paralysis of the heart, and earnestly warns his colleagues against the use of that salt.

Dr. Wachsmuth's favourable results are confirmed by Dr. Pauli of Lübeck and by Dr. Wegele in Franconia. The former, in a paper (read before the German Scientific Association in Cologne, 1888), asserted: "*Even in severe cases, with thick, extensive, putrid-smelling membranes, it was possible to see the latter diminish often* in two to four, mostly within three days; and frequently we had the opportunity to observe how the most extended false skin became loosened within twenty-four hours and could be wiped away without great trouble, especially in cases which came early under treatment".

Dr. Wegele, although working in a country district under very unfavourable circumstances, lost only two patients out of forty-seven.

Dr. Wachsmuth gives the number of cases treated, as also the deaths, and this list has, he declares, been attested by Government officials. He treated privately during the years 1876 to 1894, 936 cases, and lost twenty-two, that is, not quite 2½ per cent., and these latter were mostly severe cases, which were well advanced before coming under treatment.

The statistics of London during 1897 [1] record 12,881 notified cases and 2262 deaths. This gives a mortality of 17·7 per cent.,[2] provided that the "serious responsibility of diagnosis" has not increased the number of notified cases, by classifying slight affections as diphtheritic. However reliable or unreliable above statistics in calculating the percentage of mortality may be, there remains the evident and incontestable fact that 2262 deaths occurred, of which 2000 (to allow for neglect and accident) should have been prevented. And these 2000 deaths stand out as a charge against the medical profession for incompetence, which all titles of honour and all the homage of mansion-house dinners will not outweigh.

The whole position of the medical faculty, in relation to the prevention and cure of diphtheria, is well expressed in the following remarks of Dr. Gottstein (in his above-mentioned treatise) :—

"The reduction in the mortality ascribed to the serum treatment is altogether so trifling that it is entirely out of the question to speak of a specific method of cure. The result does not justify the enthusiasm which is shown everywhere ; but it should incite to further sober therapeutic experiments, especially in the direction of infusing indifferent (neutral) common salt solutions which have hitherto not been used for diphtheria, and the action of which would not be interfered with by the addition of albuminoid subtances (the antitoxins)."

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[1] *The Lancet*, 22nd Jan., 1898, p. 266.

[2] *The British Medical Journal* of 2nd April, 1898, reports a mo
London for the previous week of 25 per cent. as the result of
the antitoxin serum, the remedy of "distinctly greatest value".

In a letter which I ventured to address to Dr. Langerhans on the death of his son from serum injection, I appealed to his professional opinion : "Is it not highly probable that . . . the infusion of a simple common salt solution into the blood will alone effect the separation of the false membrane . . . ?" without having to resort to the employment of an organic poison which killed his son.

And what is the outcome of the above demonstration? you perhaps very pertinently ask. Let me summarise what has already been indicated in several remarks, and offer the following advice to parents : Should any symptom indicate an approaching ailment, do not hesitate one moment to apply this simple remedy : internal administration of a salt solution in small quantities repeatedly during the day combined with *warm strong brine bath*. There will be no need to wait for a bacteriological diagnosis (performed at short intervals) to decide whether it is a simple cold or croup or a light or a malignant attack of either scarlet fever, diphtheria or any other ailment, but prevent the further development of the attack into more serious symptoms. And the use of common salt, as advised above, will not interfere with any treatment which any physician of acknowledged standing may consider necessary.

I contend, however, that by following my advice of supplying the body with a daily quantity of sodium-chloride, no one will be liable to a serious attack of any of these disorders. Schools, work-houses and similar establishments will very soon experience the full benefit, if following the advice, and will readily join in the praises of this "glorious gift of God," *common salt.*

CHAPTER XLIII.

INFLUENZA.

Of all diseases this is the most insidious. There is a certain mysterious character about it; and scarcely any other disease is so manifold in its symptoms. It begins, perhaps, as a simple cold, and—if not fatal—ends by breaking up the whole system. One attack, safely passed through, does not protect against a second; on the contrary, it leaves behind a predisposition for a renewal.

But in this, as in all other disorders, if not more so, there is a great difference in the severity of the attack in different people. Children mostly pass through it with little disturbance to their system; but in elderly people it searches out the weakest part of the organism, and—if it does not kill—it leaves behind some serious affections of a local nature, either in heart, lungs, kidneys, but especially the nervous system, which ultimately end fatally. Mortality, on the whole not great, increases with the age of the sufferer.

In children it mostly begins with a slight fever, a general feeling of faintness, vomiting, indifference to everything around them, a cough, etc., and after one to three days the fever ceases and they get well, without the catarrhal symptoms having fully developed. In adults it also commences with feverishness, headache, general depression, but develops more gradually; and—according to the previous state of health of the patient

—either passes away or assumes a serious character, mostly in affections of local organs. Severe headache, vertigo, neuralgia, pain in various parts of the body, etc., arise, and catarrh, cough and diarrhœa change suddenly from one to the other. The pulse becomes weak and irregular, which is mostly a fatal indication; or the catarrh is the principal symptom, involving the throat and the lungs; or the whole range of digestive organs are attacked. And, as already stated, if the patient recovers, there remain the sequelæ to be guarded against.

As to medical treatment, Dr. Dippe[1] openly admits that little or nothing can be said about it; and he adds: "Who is strong and enjoys good health, has a great advantage in resisting an attack".

Although it is now assumed, that the ubiquitous bacillus (named after its inventor, or, I should say, discoverer, Pfeiffer) is the causative agent of influenza, this has not advanced the question of prevention or cure one iota. You cannot make the bacillus harmless without strong measures, and to attempt the killing of it inside the human body would endanger the patient's life.

The drugs used are numerous.[2]

"Slight cases require almost nothing; a little cooling saline medicine: citrate, acetate, or nitrate of potash."

The danger of potash salts has been pointed out already, and common salt does not exist for the medical mind.

"In severe cases, calomel (mercury), followed by a saline purgative. But neither mercurial nor other purgatives should be too freely or repeatedly given, as the intestinal mucous membrane is irritable." Among other medicines *tried* are the following: mercury, antimony, ipecacuanha, tartar emetic, nitrate of potash, conium, henbane, tincture of lobelia, opium, Dover's powder, squills, senega, liquor morphia-muriatis, bimeconate of morphia, serpentaria, ammonia, acetate of lead, quinine, etc., etc., and externally, blisters and leeches, with sundry other "healing" agents.

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[1] Dr. Dippe, *Infections-krankheiten*, Leipzig, 1896.

[2] Reynolds, i., p. 27 *et seq*.

After this array we are naturally reminded of Faust's exclamation :—

> Hier war die Arzenei, die Patienten starben,
> Und niemand fragte : Wer genas ?

"In future epidemics it would seem very desirable *to try* various inhalations, to act on the membranes of the nose, pharynx and lungs. It is impossible, *a priori*, to say *whether they could be of any use*, but small quantities of chlorine, iodine, carburetted hydrogen, even perhaps sulphurous acid, might be tried." All highly poisonous gases to be inhaled by the lungs.

This was written previous to the year 1866; there is, however, no evidence, that curative medicine has improved since then. At all events, the mortality, allowing for variation in epidemic virulence, has not diminished.

There are several phenomena connected with this disease, which seem to point to the fact, that the natural immunity against it is dependent upon some simple question in the condition of the organism; and all that has been said with regard to a natural immunity, and a difference in the violence of an attack in other diseases, applies with equal force to influenza.

Taking all the symptoms together, this disorder impresses one with the idea, that the great susceptibility must be looked for in a *thorough enfeeblement of the nervous system in relation to the physical as distinct from the mental life of the organism.* To make my remark clearer, I must recall to your memory, what was said about the effect of water on the nerves; and this "diagnostic suggestion" will be strengthened by a closer consideration of the various symptoms. These latter will point to a diminished influence of the nervous system on the functions of the various organs; the nerves themselves acting in the manner, as referred to in the experiments undertaken, to show the effect of water on the sensibility of the nervous system. And that common salt can be of benefit in such cases cannot be doubted by any one, who has once experienced the effect of the liberal supply of it to the system.

And more so still, when we take notice of the various premonitory affections, which are of so general a nature, that, as stated in *The British Medical Journal*,[1] "The (gastric) symptoms (of influenza) are in many cases so severe and pronounced, that the most experienced physicians have, in individual cases, felt some hesitation for several days in rejecting the diagnosis of typhoid fever". To await the full development of the disease, without which it is not possible to select the proper drug, would be in accordance with the art of the savage medicine-man, but . . . ?

The effect of sodium-chloride generally on the human body, as depicted throughout this treatise, speaks for its more than probable effect in combating the early symptoms of influenza; and its action on the nerves through the extraction of water, recommends it as of special value to strengthen the nervous system generally.

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[1] *British Medical Journal*, 5th Feb., 1898, p. 389.

And again I maintain, that—in face of the inability of the profession to either prevent or cure the disease, as evidenced by the number of deaths, not of poor patients, but of persons of education and in affluent circumstances, whose decease is a loss to the community, and who certainly have had the best medical advice—medical men are not justified to slight a suggested means, which has every physiological support on its side.

That I and my household (consisting at the time of five persons) should have escaped during all the years of the epidemic, when neighbours all round suffered, and when my daily avocation brought me constantly in connection with the very class of people, who would carry the disease germ about with them—this cannot be explained by the assumption of *accident.*

CHAPTER XLIV.

SMALL-POX.

It must appear futile, either to express an opinion upon, or to make an inquiry into the subject of small-pox and its prevention, considering the ideas, which have taken possession of the professional mind; for: whatever is said about it or only suggested, it is met by a reference to vaccination as a perfectly satisfactory solution of the question.

This can be answered only by a complete and extensive treatise, which would be out of place here, although small-pox should be named among those diseases, in which sodium-chloride will prove itself an effective prophylactic agent.

I shall justify this assertion in a separate treatise, but will here only indicate the scientific standpoint, from which small-pox and vaccination should be judged.

All assertions, made by medical men as to the efficacy of vaccination, have been based upon statistics; and these have been worked and used in such a manner, that it has become proverbial "statistics can be made to prove anything".

It has never been possible to bring forward any physiological or pathological proof, why vaccination protects against small-pox; until within recent years it has been declared, that Pasteur's experiments on anthrax and the serum treatment have given a logical foundation to it. This would appear, however, to be based upon a confusion of the respective processes involved; and vaccination remains in the same position as before, that is: it rests on the assumption, firstly, of the identity of variola and vaccinia; and, secondly, of an absolute (or in medical language "almost absolute") protection afforded by a slight attack of cow-pox against an attack of small-pox.

The effect of an attack of this latter, as also of vaccination and the resulting protection for life, has been explained as consisting of a destruction of some constituent of the blood, which formed the pabulum of the disease; and with the elimination of the poisonous products by way of the skin, the body recovered and was thus protected. Let us see what answer we can give to that explanation.

We will take two "properly" vaccinated persons; feed one of them on an ample diet of meat, eggs and other nutriment rich in blood-forming substances; and the other on farinaceous food, such as bread, rice and watery vegetables. He will certainly be a bold man, or be blinded by professional prejudice, or will shut his eyes to practical physiological teachings, who will guarantee, that the blood of these two people has not changed, and has not been so much altered—let us say in four or five weeks' time of such feeding—that the one will be again liable to an attack from which the other will escape.

In fact it is acknowledged, that in the human body nothing is subject to so many and sudden changes as the blood; and how untrustworthy the explanation of a destroyed blood-pabulum is, and how little reliance can be placed upon the assurance of a life-long immunity against a second attack, is unwittingly admitted by the profession, when gradually shortening the interval, after which doctors declare, that revaccination becomes necessary.

First it was promised: protection lasts during the whole life; next, only until puberty; then only for ten years, and then for five, till finally it has been seriously proposed to repeat the process every twelve months. What a scientific fiasco.

And how little confidence medical men themselves logically place in the protection against small-pox, is evidenced by their clamour for universal vaccination. My neighbour, a doctor, vaccinates his child and then declares, that it is protected. Nevertheless he insists upon my child being also vaccinated because (he asserts) it may become a source of the disease and infect his *protected* child. Was there ever such logic?

For, be it understood, the enforcement of vaccination is not so much based upon the care which the State takes of my child, as it is on the pretext of preventing the spread of the malady. And what opprobrium has not been poured out upon those, who have conscientiously resisted this restriction of personal liberty?

Who is really the fanatic? The man who resists this interference with his right of Habeas Corpus? or the doctor who with the aid of the police enters into every "Englishman's castle" to vaccinate against the wish and will of the "free-born Briton"?

The time will come, when the profession will be surprised to discover the true nature of variola; how vaccination protects; for how short a time it does so; and most probably: that small-pox can, under specially arranged conditions, be produced *de novo*. Until then the legitimate doctors and an omniscient parliament will enforce vaccination.

In anticipation I can only advise you, take your salt and defy the infection.

CHAPTER XLV.

LIFE IN THE TROPICS.

IN a letter to *The Daily News*, 7th March, 1898, Mr. G. J. Holyoake calls attention to the great mortality and sacrifice of valuable lives among the civil officers on the west coast of Africa, especially Sierra Leone. He instances the death of "Chief Justice Hindle in his fourteenth month of service. Two governors in that region are among the recent dead. The last post brought news of the death of Mr. Willbey, Curator of the Botanical Station, about thirty years of age, who died in his fourteenth month. Taken ill in the afternoon he died at noon the next day, and was buried at 8·30 the next morning. *Dr. Prout, the colonial physician, was sent for, but he was ill and could not come.* Within little more than a year eighteen officials have perished."

This is most appalling; and one may well ask, Where is Medical Science? That such mortality can be prevented is not only a matter of belief, but is attested by facts. I once received the assurance of an old sea captain, that he had spent twenty-five years at Sierra Leone, and had never suffered a day's illness of a serious nature. And his looks supported his assertion.

It cannot be otherwise than aggravating to notice the tone assumed by medical writers on the fevers of tropical and sub-tropical regions, as instanced in a leading article of *The Times* (20th August, 1878)—unquestionably written by a medical man—about a fever which broke out among the troops in Cyprus, in which it is stated that, "the nature of all fevers is now sufficiently understood by those, who have studied them, to render it certain that the one, which prevails at Cyprus, will be subdued as soon as it can be made the subject of thorough medical investigation, and of such medical, hygienic and preventive treatment as that investigation may show to be required".

We all know, that there is nothing perfect under the sun, and medical science and art shares in this imperfection; but it is unpardonable to boast about the certainty and the prospective achievements of medicine, when the facts prove the contrary.

Let us but take the case of Sir Gerald Portal, who for several years lived in Zanzibar, travelled repeatedly through the malarial littoral of East Africa; and, although attacked by fever, was able to perform his duties in a tropical climate.

Coming home to England, to report upon his mission to Uganda, he dies, although he has the advantage of being attended to by the highest talent in the profession, attested in their distinguished position by titles and orders. And such cases may be multiplied, if needed; but we are surrounded by them. The writer of the above extract from *The Times*—if I mistake not—is in his own decease at a comparatively early age, an example of medical inability.

In the whole subject of sociology and of human life on the globe, there is no more important subject, especially when the future of the human race is considered, than the adaptability of the inhabitants of the temperate regions to a tropical climate. More than ever do we find the white man invading the torrid zone; and with all the greater pressure will the question of human life in the equatorial regions be forced upon our attention.

The effect of heat, under varying conditions of dryness or moisture, we can study, however, within our own surroundings, since many cases of heatstroke, or sunstroke, frequently happen in the temperate zone under exceptionally high temperature; and we will consider this question first, before we inquire into the effects of a warm climate in the causation of fevers.

I am involuntarily reminded, whenever the word "heatstroke" or "sunstroke" is mentioned, of Goethe's words:—

> Denn eben we Begriffe fehlen,
> Da stellt ein Wort zur rechten Zeit sich ein;

for, What is heatstroke, or sunstroke, or heat-exhaustion?

In a Turkish or hot-air bath, bathers can remain for half an hour and longer, and this in an atmosphere heated to near the boiling-point, and no one suffers from heatstroke, although the time is sufficiently long for so high a temperature to show an effect if heat, as such, produces it.

The *Scientific American* a few years ago collected some interesting facts relative to the extreme temperature of different parts of the world.

"In Thibet the inhabitants suffer from an extreme summer temperature, which is stated to rise to the almost incredible heat of 150 degrees in the shade. It is not known by what devices the natives escape the effects of this frightful temperature." This is sufficiently remarkable—considering that the heat lasts unquestionably for several hours continuously—to show that high temperature alone will not produce heatstroke.

Dr. Luigi Sambon, of Rome,[1] who maintains that Europeans can work in a tropical climate without suffering hurt, refers, as "a good illustration, to the tea planters of Assam. They have to labour in the hottest season and at the hottest time of the day, and they do not suffer from the heat."[2]

Besides this, it is a well-known fact that in such heat the temperature of the blood—and with it that of the nervous system—is only infinitesimally increased; far less than is the case, when the body suffers from fever. It is hence not the heat directly, which causes the sudden attack of syncope and of death.

But, you will suggest very likely, is it not the direct and still unexplained effect of the sunbeams striking on the head or the body and thus causing these fatal effects? Let us see.

During the summer of 1896 we had in London for weeks together an unusually high temperature, and the newspapers reported almost daily a number of cases as heatstrokes.

"An omnibus driver . . . died at Hammersmith on Wednesday *evening* from syncope, the result of a sunstroke." It does not say, unfortunately, whether the "sunstroke" took effect at the time of the day stated or earlier; but from the context we may assume, that the sufferer was "struck" down in the evening.

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[1] *Daily Chronicle*, 15th Jan., 1897.

[2] Dr. Sambon's endeavour to explain sunstroke (*Nature*, 31st March, 1898, pp. 516-7) by the assumed entry into the human body of a specific microbe, is one of those hyper-scientific attempts, which serve only the purpose of impressing the ignorant half-educated public with an idea of the depth of medical science; but which, owing to this very depth being unfathomable, disappear from the arena of true science. Medical men vie with each other in the discovery of new fields of activity for the bacteria. If any phenomenon remains inexplicable, electricity and bacteriology come to the rescue, whether applicable or not.

The next case is more decided: "At the Islington Coroner's Court, Dr. Danford Thomas . . . held an inquiry with reference to the death of W. A. Foster, aged forty-nine; . . . the daughter deposed, that on Tuesday *evening* last she went for a ride with her father on a tramcar. . . . When outside the Upper Street Police Station he suddenly threw up his hands . . . and died in about three minutes. Dr. Henry Preston said that death, in his opinion, was undoubtedly due to sunstroke caused by the heat."

Both these cases—and many others could be cited—happened at a time of the day when anything else, but not the direct rays of the sun, could have been the cause of so sudden a death. And instances are related of soldiers suffering in hot climates from sunstroke whilst in sheltered, *i.e.* well-shaded, situations.

Therefore, neither the heat nor the sun's rays have any direct mortal effect on the body; we have to seek for an explanation elsewhere; and our past inquiry into the cause of most cases of heart failure and of sudden death will assist us here to explain the phenomenon. The verdicts at the various inquests, based upon medical testimony, fully confirm it, that the blood is at fault; syncope, apoplexy, heart failure, is but the result of want of oxygen in the blood.

In short, the great heat excites to copious drinking; this washes the common salt out of the system; as a result, the blood corpuscles swell, are incapable of supplying oxygen to the heart and brain; they even burst; the potash salts diffuse in the serum and cause the heart to cease beating; and whilst the unoxygenated blood cannot maintain the life of the nervous system, *sudden death is the result; indirectly produced by the heat.*

The British Medical Journal, cited by *The Daily News*, 18th August, 1893, partly points to this as the true explanation of sunstroke when saying: "The cardiac cases often are hopeless from their suddenness," and the writer advises, "where it can be obtained, the inhalation of oxygen". Very scientific. Is, however, the blood in a condition to take up the oxygen? This never struck the writer in the medical paper.

The great heat wave, that passed over the United States in 1896, must still be in our remembrance, as it demanded its daily victims in considerable number. "The parks were kept open at night to enable people to sleep in the open air;" as often the nights were as hot as the days, the heat, absorbed by the houses during the day, radiating during the night. And it is this continued heat night and day, so different from the cool, almost cold nights in Thibet, which accounts for the greater thirst and the continued imbibing of liquids to replace the loss of water by perspiration.

This would also explain the fact observed by Mr. James Bryce,[1] and reported in his *Travels in South Africa.*

"Sunstroke is unusual, and one sees few people wearing, even in the tropical north, those hats of thick double felt or those sun helmets, which are deemed indispensable in India. In fact, Europeans go about with the same headgear, which they use in an English summer. But the relation of sunstroke to climate is obscure. Why should it be extremely rare in California, when it is very common in New York in the same latitude?"

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[1] *Impressions of South Africa*, by Jas. Bryce, London, 1897.

It is remarkable that in questions of this nature, attention is always concentrated on the phenomena outside the human body, and is never directed to internal conditions of the organism as influenced by the climate.

Let us attempt to answer Mr. Bryce's question by the result of our past inquiry. In a dry, hot atmosphere, the thirst is induced by the loss of water from the system; drinking is the consequence. But the water does not accumulate in the body, as it leaves the body again by perspiration, owing to the dryness of the air. In a moist, hot atmosphere, however, the evaporation from the skin is greatly checked, and if we add to this, that, as is much in vogue at New York, *a large quantity of iced water is consumed not because the system has lost water*, *and not for quenching the thirst*, *but for the purpose of cooling the body*, we can easily understand that the blood becomes surcharged with water, which destroys the blood corpuscles, and thus causes all the phenomena called "sunstroke," "heatstroke," or "heat-exhaustion," and all this because *sodium-chloride has been washed out of the blood*, *and has not been replaced by a fresh supply*, *commensurate to the water imbibed.*

There can scarcely be any doubt remaining in our minds, that—in so far as it maintains the red corpuscles in their normal condition for the performance of their function: the absorption of oxygen for the life of the organism—*common salt assists in the prevention of sunstroke.*

In relation to tropical fevers, it must suffice here to point to the fact, that unquestionably the liver is greatly implicated; and when referring to the diseases incidental to India, a writer in *The Times* (21st December,

1871) states, that "heat-apoplexy and hepatitis, or in other words, sunstroke and liver complaint, would represent the special liabilities of Indian service".

It is not necessary here to enter into the important functions of this principal gland of our body, or to point out its connection with the blood and the nutrition of the nervous system; we need but recall to our mind what was said on this subject, when we inquired into the connection of common salt and the liver, and remember that sodium-chloride is a normal ingredient of the blood for promoting the formation and the secretion of bile; and that, if not the principal factor, it certainly is of the greatest necessity for the prevention of abnormal morbid changes in this important liquid, and plays an essential part in all its functions.

The rapid decomposition, to which the human corpse is so liable in hot climates, should be accepted as an indication, that the body had been suffering from a dearth of common salt; from which we may deduce, that the insufficiency of this protector of the blood was contributory to the disease and to the fatal issue. But here again I must warn against that remnant of the savage medicine-man's view of looking upon common salt as a specific, and that a dose or two should produce a medicinal effect on the system. The whole course of our inquiry points to the fact that it should be supplied daily, as a food; and in a tropical climate no beverage, no liquid of any kind should be taken without a compensating amount of common salt accompanying it. So supplied, the human body will be able to bear the greatest heat, provided that it is of ordinary health, and that other hygienic measures such as diet, clothing, bathing and exercise receive proper attention.

In no case would the beneficial result of a liberal supply of common salt become more evident, than in that of our soldiers in India. Not only would the percentage of invalids and hospital patients be considerably reduced, the lives of many soldiers saved, but—what would touch the Government's and the tax-payer's interest more forcibly—thousands of pounds would be saved in consequence.

And the trial is so simple and costs so little. But ignorance, prejudice and the halo of medical prestige stand in the way—to which the unlearned lay-public must bow and submit.

To the Europeans in the Tropics I would say: never —if your circumstances permit—take a bath unless it contains common salt (see *ante*, Bathing); but above all, never take any liquid without you take—during the day —a compensating amount of salt, and this is best taken independent of food. Let the salt bottle stand near the water bottle on your table as well as on your washstand; and I am sure that you will bless the hour, when you accepted the advice: of adding to your daily allowance of food and drink a certain and liberal supply of *common salt.*

CHAPTER XLVI.

THE SALT TAX IN INDIA.

THERE is no writer, I think, on the subject of common salt in relation to the animal economy, who has not in language, more or less severe, condemned the imposition of a tax on this necessary food ; and the only excuse that can be advanced on behalf of those with whom the responsibility rests, is—if not absolute ignorance—at least an erroneous conception of the facts involved.

Liebig,[1] basing his condemnation on the necessity of sodium-chloride for the human organism in its general aspect, calls " the impost on salt of all taxes that which is the most odious, the most unnatural and the most disgraceful to human reason ".

Prof. Bunge rests his disapproval of the tax on the social distinction between rich and poor, by pointing out the class of nutriment which serves the latter for their food. He[2] directs our attention to all those vegetable substances which are comparatively rich in potash salts, *viz.*, potatoes, rye, peas, beans, and these form the staple food of the European proletarians, and together with rice of our Indian fellow-subjects. " This fact," he says, " illustrates the injustice of the salt tax. For—the poorer the human being, the more is he forced to subsist on a food rich in potash, and the greater is his demand for salt. The salt tax is, in relation to the consumer's wealth, a progressive tax ; but in the inverse ratio : the poorer the man the greater the tax ; *it can hardly be matched for its artfulness*."

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[1] Liebig's *Letters*, p. 410.

[2] Bunge, p. 117.

Schleiden,[1] like Bunge, refers to the cunning which dictated the imposition of the tax ; it reaches even the very poorest, and is thus the most unjust and barbarous impost ever levied. He gives a historical survey of the tax in various countries, and cites cases of rebellion on the part of the populace against this cruel imposition. That the tax, as also the opposition to it, has existed from time immemorial is evidenced by traditions such as the following :—

An attempt was made to demand payment from the drinkers of the medicinal waters of Aedepsus, whereupon the well ceased to flow.

Lysimachus, one of Alexander (of Macedonia)'s generals, levied a tax upon the salt at Troas, when the salt vanished and only reappeared, when the tax was abolished.

To invent these mythical stories was, as Schleiden remarks, the only means by which the people could revenge themselves upon their oppressors ; they branded the salt tax legislators in the eyes of future generations.

Consul Livius (during the second Punic war) was thus nicknamed " salinator " (salt pedlar).

Victor Hehn in his charming little booklet (*Salz. Eine Kultur Studie*) relates, that the despotic court of France in the last century formed at Versailles during the summer months a surface for sledging parties by covering the road with salt. This brought down upon the aristocracy the execration of the poor people, who were heavily taxed for the use of common salt.

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[1] Schleiden, pp. 98-99.

The full extent of the cruelty inflicted by this impost becomes apparent, when we learn the expedients, that Governments have to resort to, to prevent an evasion of the tax. A friend, who lived for some years in Italy, refers to it in one of her letters to me : " I remember in Italy along the Mediterranean, that guards are posted at intervals along the coast, and I learnt, that they watch to prevent the sea-water from being taken by the people to evaporate for a salt supply ".

England, which perhaps levied the highest tax, was the first (excepting France during a few years of its revolutionary period) to abrogate the imposts, namely in 1825 ; but in no country does this cruel tax press heavier upon a poor populace, than in India. It is a noticeable fact, that during the recent frontier war, when the hill-tribes submitted conditions for a settlement of pending questions, the first demand was a re-adjustment (not even a total remission) of the salt tax, showing, that in outlying districts, which were not even under the direct administration of the Indian Government, the question of cheap common salt was paramount to every other, which had arisen in the relation of these tribes to the Indian Empire.

When some years ago, in a conversation with the late Sir Bartle Frere, I touched upon the salt tax in India, he gave me the assurance, that the amount of this tax was not so high as to prevent every individual inhabitant from obtaining the small amount he required ; and a similar reply was given by an old Indian —a military gentleman.

This view is, however, shaken by the opinion ot others, evidently well acquainted with the subject. Mr. St. George Tucker's letter in *The Times* of 31st January, 1883, which is mainly directed against an increase of the duty, contains the following remarks: "If we consider, that the wages of unskilled labour in some parts of India do not exceed twopence per day, we shall be able to understand that a labourer cannot afford to pay one day's wage for 1½ lb. of salt for himself, his family and his plough bullocks, if he should possess any. Millions of natives consume salt which has not been taxed; millions of natives consume less salt, than is required for health; and millions of natives consume unwholesome minerals, such as Glauber salt, instead of good Cheshire salt. . . . Our duty to the natives of India demands, that a higher rate should not be exacted till wages rise."

I contend, however, that it is our duty to abolish the impost altogether; and I base my contention on the following reasons:—

1. *The health, nay, the very existence of every human being depends upon a regular supply of common salt.*

It is impossible to deny the truth of this assertion, unless it is done in violation of well-ascertained and incontrovertible facts. Every human being must have a certain amount of common salt to sustain life and maintain health.

2. *There is no other substance in nature, which can take the place of common salt in the animal economy.*

If wheat and bread were taxed, we could find a substitute in other cereals, or in the leguminosa or other vegetable food-stuffs; but there is absolutely no substitute for common salt. To my mind this is the weightiest, the most impressive reason for opposing any and every impost upon salt. This fact should morally force the Government to abrogate the tax, and to insist, that the price of salt is not increased by any private speculation, or by any grasping "middleman". Its supply at the lowest possible cost, and the facility of its distribution, should be the constant concern of the administration. The result would be a healthier populace, the saving of national and social energy—the loss of which at present, through disease and death, can be counted by millions of pounds sterling.

3. As has already been pointed out above, in a country, where the bulk of the people subsist chiefly, if not entirely on vegetable food, the tax on salt presses heaviest on the poor.

It is hence the most cruel, the most barbarous tax ever levied ; *and the law, which permits the enforcement of it, is in the hands of the Executive—the pistol of the highwayman who demands "your money or your life"*.

We should never lose sight of the fact, that it is not only the food rich in potash salts, which demands the liberal supply of salt to the system, but also the great quantity of water, which passes through the organism to quench the thirst and to cool the body in an atmosphere of high temperature. And such climatical conditions as we find in India—high temperature, combined periodically with great moisture—are certain to develop in the human body, if not liberally supplied with common salt, a high degree of susceptibility for all the diseases, which are endemic in India ; keeping the pest, cholera, and the various fevers as a constant plague in the land.

It has often been asserted that, even were the tax abrogated, the natives would not use any more salt than they do at present. This may find, to some extent, an explanation in the ignorance of the people of India with regard to the prophylactic powers of common salt against the predominating endemic diseases; but if they had once become convinced of the protection afforded them, by never drinking water unless it contained some salt, they certainly would not neglect so simple a means to ensure health and—with all their fatalism—to prolong their life.

It is not at all improbable that it is felt, it may be unconsciously, even by the uneducated natives, that common salt is a positive necessity for their existence; that it is impossible to find a substitute for it; and that through this dim sense of the cruel wrong they have to submit to, in paying the impost, an opposition is developed towards the use of salt—not because it is dear, but simply because it is taxed—which induces them to purchase no more of it than is absolutely necessary. Certainly it incites to the breaking of the law.

In the House of Commons (see *The Times*, 16th May, 1884), in answer to a question by Mr. Burt, the Under-Secretary of State for India admitted, that *in Madras alone*, during the official year ending 31st March, 1883, "*15,004 natives were arrested* for being in possession of illicit salt. Of these persons, 48 per cent. were dismissed by the salt department with a warning, and 7836, or 52 per cent., were sent for trial before the nearest magistrate, of whom" (of the accused) "93 per cent. were convicted."

He further admitted that, at that moment the tax on salt in Madras was double, what it was in the East India Company's days.

I am not in a position to state, whether the affairs relating to the salt tax are still the same, or have altered either for better or worse, since the above date. But I do not hesitate to say that the salt tax is the blackest spot in the history of Great Britain's reign in India; and a full knowledge of its barbarous character will, I trust, lead to an agitation for its abolition. The only exonerating excuse for its present existence may perhaps be found in the ignorance, on the part of the responsible legislators, of the incomparable importance of salt for human life in the tropics, where heat and moisture attack the human organism with fatal results, unless it is protected by a liberal supply of *common salt.*

CHAPTER XLVII.

SALT AND INFANTS.

If this inquiry can do no more than bring to light and impress upon parents and those in charge of children, the overwhelming benefit which infants and children can derive from the judicious use of common salt, it will repay a thousand-fold the labour and expenses involved in writing and publishing these pages.

Could we but peep into the privacy of the nurseries or the children's hospitals to watch these innocent little sufferers, whose entry into life is beset by so many forms of physical affliction ; to observe the anguish on their pale faces, the dulness of their eyes, their struggle with an invisible foe, hear their cries and groans that it cuts one's heart in twain ; and notice beside their cot a mother's anxious watchful face, with deep mental suffering depicted in every feature—who would not gladly help in ameliorating so much undeserved suffering and assist in breaking down the barrier of prejudice, ignorance and professional bias, which stands in the way of the adoption of a simple natural means for such a laudable object?

It is declared that the sins of the parents shall be visited upon the children and children's children. Although nature confirms this admonition, and more or less impresses on the offspring the parents' physical or mental defects, still we should not fatalistically accept this as an inexorable ordinance, nor scorn in our conceit even the apparently insignificant means, which promises us an increase of our influence on the health and life of our children.

But where this only applies to a comparatively small number of cases, we have on the other hand the thousand instances, in which ignorance, if not even sometimes professional prejudice, inflicts an unheard amount of suffering on innocent children. And with the object of reducing this suffering to a minimum, I appeal to mothers for their attention to the following remarks.

"When we learn from incontestable evidence," says Dr. Andrew Combe,[1] "that between one third and one half of all the children, ushered into the world, die within the first five years after birth, the conclusion naturally come to is, that such a frightful result can arise only from some great and widespread errors in the ordinary management of the young. Did it occur in wild and barbarous regions only, it might seem a natural consequence of the hardships, by which even infancy is there surrounded. But the startling circumstance is, that it happens in the midst of comfort and civilisation, precisely where knowledge and the means of protection are supposed to abound."

This state of things cannot be owing to a dearth of medical men; they "abound". But we know that the physician stands powerless at the bedside of the little patient, who is suffering from one or the other of the many constitutional ailments, to which infants and children are so liable. We further know, that notwithstanding the noisy attempt to ascribe these diseases as the result of dirt, of inefficient sanitary municipal arrangements, unhygienic construction of buildings, even want of personal cleanliness, etc., the "diabolus morbus" enters the palace as well as the hut, and demands his victims among the high and the low, irrespective of the greatest filth or the most scrupulous cleanliness. The explanation of this phenomenon we can find in the individual predisposition among the children. Let us endeavour to obtain some information about this question, beyond what we have already learnt under the headings of "Typhoid and Other Fevers" and "Diphtheria".

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[1] Dr. Andrew Combe, *Management of Infancy*, 9th ed., Edinburgh, 1860, p. 39.

Every part of our inquiry must have impressed upon your mind the necessity of supplying common salt daily, in proportionate quantity, to the human body; and your own logic will decide, without your attention being directed to it, that this necessity applies in an equal degree to infants and children. In fact, if we interpret the teachings of physiologists correctly, we should assign to the growing human organism a greater need for sodium-chloride, than to the outgrown adult.

Prof. Lehmann[1] gives us the following information on this point, after enumerating sundry processes in which cells are constantly found accompanied by sodium-chloride—in mucus, in cartilage, in the hair, etc., and he says: ". . . when we observe that the greatest amount of this (common) salt is found in the structures, which are richest in cells, we shall scarcely be falling into error if we seek to establish a very *intimate relation between the presence of this salt and the formation of cells*". And this view is supported by most eminent physiologists.

Let us now remember, that our body is but an aggregation of cells; that the child can only grow by the formation of new cells; that furthermore the whole metamorphosis of tissues—which in the body of the child is proportionately very great—demands the presence—and that the various excretions resulting therefrom constantly deprive the organism—of common salt: we are forced to admit, that, by withholding from the child's body this necessary mineral food, we not only check its physical development, but also expose it to the attack of various morbid influences, and produce a susceptibility for all the infantile disorders.

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[1] Lehmann, iii., p. 244.

The necessity of sodium-chloride for the growing child is further illustrated by the facts, which have been brought to our knowledge by several physiological experimenters, from which we are justified to conclude, that the presence of common salt, in some still unexplained way, assists directly or indirectly in the formation of bone and muscle, by its interaction with the calcium and the potassium salts in the system.[1]

Convinced of the absolute necessity of salt for the health and growth of the child's organism, we very naturally ask: what information we can glean from the doctors and others, who have offered us their professional advice on the feeding of infants and children, on the use and the necessity of common salt.

Dr. Andrew Combe[2] in his *Management of Infancy*—which must be considered as a standard work on the subject—deals with the question of infant feeding in a chapter headed "Artificial Nursing". He advises us: "When a child is to be reared by hand . . . the kind of nourishment best fitted to supply the place of the mother's milk . . . is ass's milk . . . but when this cannot be obtained, cow's or goat's milk, properly diluted and *sweetened*, may be substituted".

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[1] Bunge, p. 121. Also Liebig's *Letters*, p. 406.

[2] Combe, *Management of Infancy*, 9th ed., pp. 147-154.

Again: "In some constitutions, cow's milk does not agree when merely diluted and *sweetened*. . . . The bouillie, in common use in France, . . . is made by gently roasting the best wheaten flour, . . . boiling it in water or in milk and water, and adding *sugar* to it." So also in the chapter on "Diet after Weaning," he recommends . . . "after waking, a little bread and *sweet* milk should be given". And a little farther on: ". . . a second meal of bread . . . and fresh milk and a little *sugar* added to the bread".

No mention is made of common salt.

During the International Health Exhibition in 1884, among the hand-books "issued by authority" of the Executive Council, was one on *Food and Cookery for Infants and Invalids*, by Miss Wood, with a preface by W. B. Cheadle, M.D., F.R.C.S. In this treatise also we find similar advice (p. 14): "If cow's milk is to be used, it must be boiled and diluted with three parts of water, and have *sugar* added".

We cannot wonder that "in spite of all care, it may be found that the cow's milk does not agree; it may cause colic, vomiting and diarrhœa". Again (p. 18): ". . . porridge with *treacle* . . . is recommended"; and in the chapter on "Food for Sick Babies," we can read the following: "A very valuable article of food is raw meat or raw meat juice; . . . a little *raw sugar* may be mixed in it . . . etc.".

Remembering what was stated above, in relation to abnormal fermentations in the stomach, we can estimate the following advice (p. 24): "Lime water, in the proportion of one-third to two-thirds of milk, will aid in the digestion of the milk when there is too much acidity in the stomach"; but we cannot be surprised if the lime water will also aid in ruining the baby's digestive powers.

(P. 25): "It is sometimes necessary to give the white of an egg only . . . with two teaspoonfuls of brandy and four of water, with a little sugar to taste".

Well may the writer add: "Utmost attention must be paid to the food of an infant that is subject to diarrhœa; the acute stage so *quickly runs its course to death*".

In a work on *The Food We Eat*, by Dr. Fothergill,[1] we are informed[2] that "the condensed milk of Switzerland is a great boon to infants". Pity the helpless infants to be fed on milk so highly sweetened. He further advises: "Where the children cannot *struggle* successfully with oatmeal porridge and milk, it may be well to try some *treacle* or butter and *sugar*". No mention is made of common salt.

Now, it is a well-known fact that unsalted porridge very easily ferments in the stomach and turns acid;[3] and Dr. Fothergill, probably aware of this fact, adds: "Where oatmeal produces an acrid feeling," . . . mix a little salt with it? . . . Oh no, but . . . "hominy porridge may be tried".

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[1] Dr. J. Milner Fothergill, *The Food We Eat*, London, 1882, pp. 106-115.

[2] After some uncalled-for bantering about women's ignorance and indignant anger at receiving instruction about babies. It is intended as a display of humour to place the doctor's learning in a stronger light at the expense of the poor unenlightened laity.

[3] A friend, when travelling in Scotland, heard a lady ask for porridge without salt, when the Scotch servant expressed her belief that it would make the lady ill if it did not kill her.

"To water, pint, add ounces four
Of meal, or just a trifle more;
And don't forget the *pinch of salt*,
Else you may think the cook at fault."

These examples of a total disregard of common salt in the preparation of infants' and children's food could be multiplied.

To impress upon parents and nurses the cruel and culpable mistake thus committed by this exclusive sweetening of food, I would advise them, that *they themselves should partake* for two or three days—if the effect does not show itself long before then—*exclusively of nutriment*, *which is made tasty with sugar only.* They will readily comprehend how nauseous such food becomes after two or three meals; they will not wonder at the fact, that "*baby cannot keep the food on its stomach*"; and out of sheer pity for the poor helpless babe (who can only express his remonstrance by vomiting and crying), will not insist, that it shall "*struggle*" *with sickly sweetened, unsalted food.*

Hence my pressing advice: First season the baby's food with salt; and if then an enticement is required to make the child eat (which probably it does not desire, for want of hunger or appetite), then add perhaps a little sugar.

Do not blame me for dwelling, apparently unnecessarily, long on this question of exclusively sweetening food. The lives of thousands of children are at stake; and it should not require long remonstrance to convince any one of the baneful effect, which such highly saccharine nutriment develops in the body. Trifling causes, especially when acting or applied persistently, can have often serious consequences; and it cannot have escaped the observation of most people, that the use of so much sugar in the shape of lollipops and confectionery, engenders a soreness in the throat and a tendency to throat affections. I cannot be far wrong, when I consider the great susceptibility of children and young people to croup and diphtheria, to be due to this pernicious habit of too much and of too *exclusively sweetened food.* Who doubts it, has the means at hand, as stated above, to try it upon himself and discover, how soon saccharated food will become nauseous; whereas such, which is seasoned with salt, even with repetition, never repels us. And here again we can learn from the "savage".

When the question of using sea-water in the preparation of bread came before the French Academy,[1] it was stated, that the inhabitants on the west coast of South America prepared their food, which, under the tropics, contains a great amount of saccharine matter, by boiling it in sea-water to counteract the nauseous effect on the system otherwise produced.

There is another aspect of this question, which must now claim our attention.

When we were directing our inquiry to the subject of sea-bathing as an effective means of supplying common salt to the system, I referred to the supposition, that the desire (if not necessity) for salt could only be explained by the fact, that man had his origin in the shallow parts of the sea; and I cited some weighty opinions and reasons in support of this suggestion. I then stated it as probable that nature intended—if we can assign an intention to nature—that our body should receive its chief supply of sodium-chloride through the osmosmic action of the skin. To my mind there is another, perhaps indirect, indication that favours this view, and which I think is of the greatest importance for the question now before us.

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[1] *Revue des Course Scientifique.*

Whenever the nutrition of the human body is the subject of inquiry, the mother's milk is referred to as a guide for estimating and for selecting our food with regard to the proportion of albumen, starch, fat and salts (mineral ingredients generally) which it should contain ; since the child grows and develops in a perfectly satisfactory manner (as far as this is generally observed) on this simple food—milk alone.

In a similar way has the milk served as a guide, when the amount of common salt has been estimated, to meet the requirements of the human body.

Here we meet with the striking phenomenon, that the milk contains a relatively small proportion of sodium-chloride, whereas all the other secretions of the animal economy approach the blood in the amount of salt contained in them—a fact, which would be explained by its great diffusibility ; the milk is a signal exception. We find as the average proportion—

in 1000 parts of blood - - - -	4·5
but in human milk only - - -	1·5

parts of common salt, that is, one-third.

The attempt may be made to explain this by the suggestion, that the baby's organisation requires less salt than that of children and of adults, whose food is of a different kind. This surmise is, however, fully answered by the investigations of physiologists, which, as has already been stated above, unmistakably prove that the body requires, during its growth and physical development, probably more than at any other period, a liberal supply of sodium-chloride.

It may further be objected in reply to the above analysis, that the amount of salt, contained in the analysed specimen, was accidentally small, as compared with blood; but Bunge has investigated this point, and calls our attention to it as a striking phenomenon, that "the mammary glands secrete from the blood plasma, *which is altogether differently constituted*, all the inorganic constituents, exactly in the proportion in which they are required for the infant, to develop an organism like that of the parent".

So that, while the blood, the lymph and the various liquids which permeate the tissues contain 4·5 per 1000 of salt, the milk contains only 1·5 per 1000. Yet the need of common salt for all the various processes of life, which are comparatively vigorous in the period of adolescence, is fully admitted; and Bunge himself, in a sentence, preceding the above quotation, declares: "The ultimate products of the metamorphosis of the nitrogenous substances cannot possibly be secreted simply in a watery solution; this process is always accompanied by an elimination of chlorides"—chiefly of sodium—thus again pointing to a source of loss, demanding an amount of salt, poorly provided for in the milk.

But since milk does not furnish the required quantity of sodium-chloride, although the child's growth and health depend upon it, how does Nature intend that the system should obtain it? From our past inquiry, and from the facts already gathered, we would answer: By way of the skin in a sea- or salt-water bath *in the very element*, in which human life's thread found its origin, and *in which even now* (after perhaps hundred-thousands or millions of years, during which the animal-man has left the sea and domiciled permanently on land) the embryo develops from the egg to the fully organised human being. The liquid (the Amnion-water) in which the embryo gradually evolves from the minute germ, and grows to the highest organism, contains from 7 to 8 per mille of salts, the chief portion being sodium-chloride.[1]

Hence, as our historico-morphological descent from ancestors reared in salt-water can account for the requirement of common salt for the various functions of our body, so can it give us an explanation of the deficiency of salt in the mother's milk, and point to the salt-water bath as the means of supplying this necessary ingredient to the body of the infant, at all events during the first period of its existence, until the change in the nutriment admits of another method of supply.

How far have we carried out this demand of nature in relation to infants and growing children? By keeping the child out of its natural element—the salt-water bath—we withhold from it that ingredient, which forms the protecting medium for its blood and its tissues, and without which it develops the great susceptibility for all the various ailments, that children so readily suffer from.

We are naturally reminded of a ceremony observed among the ancients, which we might well accept as a hygienic hint. Was it intuition or a knowledge of its sanitary virtues, which induced the Hebrews to rub salt into the skin of the newly born children?[2] Although this process may have had a religious, a symbolical meaning, according to which the child was to be purified before its admittance into the covenant with God, still we must remember, that many of the ancient rites and ceremonies were in fact sanitary and hygienic measures, to which a holy character was imparted for the purpose of enforcing obedience to these laws.

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[1] Prof. V. Hensen, Hermann, vi.b, p. 279. Also Drechsel, Hermann, v.a, p. 619.

[2] Ezekiel xvi. 4.

Let therefore the children, from the moment of their birth, enjoy the frequent benefit of a salt-water bath. It is just during the suckling period that infants are most susceptible to many diseases, when a salt-water bath is the only medium for supplying this grand gift of nature to their young body for their protection. Besides, it is necessary to bear in mind, that the salt of the bath acts beneficially as an irritant on the skin. The skin is the outside boundary of our nervous system. By a judicious excitation of the skin, we excite the nervous system to a healthy activity, *and activity is life.* The natural normal means for such excitation are : dry friction, low temperature and the salt of the bath.

Let us further remember, what has already been twice brought to our notice, but cannot be repeated enough, that in a warm fresh-water bath the water is absorbed into the system ; it loosens the general tissue, makes it flabby, lessens the faculty of the blood corpuscles for absorbing oxygen, and thus weakens the organism generally by its destructive action, as Prof. Burdon-Sanderson expresses it. In a salt-water bath of a sufficient density, *i.e.*, higher percentage of common salt than exists in the blood, the contrary is the case. The denser solution of salt in the bath tends to deprive the organism of superfluous water, whilst the body absorbs the salt by osmosmic action of the skin, imparting to the system the advantage of a stronger blood, and hardening the body by giving it greater powers of resisting disease.

Intuitively, salt has in past times been highly estimated in connection with children's physical welfare. In the Latin Church a pinch of salt (parva mica) is put into the child's mouth at baptism, the priest saying: "Receive the salt of wisdom" (sal sapientiæ—here no doubt meant in a symbolical way; producing, however, a physical and hygienic effect), "and may it be a propitiation to thee for eternal life".

Dyer tells us in the *English Folk-lore* that when a child first leaves its mother's house, it is, in Leicestershire, Lancashire and other counties, presented with salt.

It will not be surprising to hear, that I was accosted by a mother with every mark of gratitude for having, as she declared, saved her boy's life; and when in momentary ignorance of the facts, I pleaded that I was not aware of ever having done so (either on the river or on the road), she informed me that many years ago I advised her, to prepare her child's food with salt. The then infant was, as she expressed it, "all skin and bone" in spite of her following the advice of many doctors and inquiring at several infirmaries for treatment. The food, seasoned with salt, "did wonders"; the boy became a healthy, plump child in about eight weeks, and the mother said that she could not attribute the good effect to anything else than the addition of the salt to the infant's food.

In 1871, having sent a copy of my first pamphlet on the effect of common salt in the prevention of disease to a clergyman, who had lost a child through a chronic disease, he related to me his experience, as fully confirming my views, with regard to the general benefit, which the supply of common salt confers upon the human organism. He writes: "I am an extremely healthy person, so far as I know, and have always been laughed at for eating great quantities of salt. . . . My little girl" (who had whooping-cough when three years of age, had a diseased spine, and died, when six years of age, of peritonitis) "did take salt with her meat, but the quantity she liked was very small. The healthiest boy of my family is remarkably fine and robust, admired by everybody; and we used to regard it as a very singular fact, that soon after he was a year old he took to eating salt. He eats it in large quantities with his food; and some year or so ago he would take up a whole salt-spoonful of salt and eat it contentedly, as if it were sugar." The writer further remarks, that he has known "habitually delicate persons who hardly touch salt".

When some twenty years ago I advised a lady not to stint her children in the use of common salt, she informed me, that when living at Munich, she and her family were on visiting terms with Baron Justus von Liebig, who told her to give to her children as much common salt on their bread and butter as they liked.

My twenty-six years' experience enables me to augment these cases to a great extent; but the above will suffice to impress upon all, who are responsible for the health and the physical well-being of children, to look upon the judicious use of common salt as one of the great factors for ensuring health and strength to the children under their care.

CHAPTER XLVIII.

SALT AND VEGETARIANS.

My object in the following remarks is not, to enter the arena for the defence of vegetarianism, as I think the battle, for gaining its acknowledgment among the people, is a slow and quietly progressive one. But the vegetarians have taken so prominent position against the use of common salt for the human organism, that I cannot pass them by without a word of remonstrance.

Their opposition is expressed—as already mentioned when answering the objections raised against salt—in the words: " It is a mineral, and cannot be an article of food " ; and in this short sentence is conveyed the vegetarian's physiological philosophy that, man only requires organic substances as nutriment.

First and foremost it is necessary to know, that organic food alone will never nourish the animal body ; the albumen and starch, even after being changed into peptones and sugar (if this process can be effected without the presence of mineral substances), will never be converted into part of our organism ; they could never form nervous matter, or muscular fibre, or cartilage, or bone, or any other tissue, were it not for the presence of certain minerals, *i.e.*, inorganic substances, which determine the metamorphosis required, to form out of *one* albumen the various parts of our organism. Thus, phosphate of potash is the salt, which determines the formation of nervous substance; it is the nerve salt; chloride of potassium is the muscle salt; phosphate of lime is the bone salt; and chloride of sodium is the cartilage salt.

Without any of these salts being present in the food, the respective parts of the body could not be built up. When speaking about the salts of the blood, we found that, as Bunge remarks, all the various mineral substances we require are more or less contained in our food in probably organic combination, except one—common salt; and if the vegetarians, when reading this treatise, have not read between the lines to know, what a friend and defender they have in common salt, I will endeavour to call their attention to it.

After Mulder's discovery[1] of the identity of the albumen found in animals and in plants, it must have become scientifically a proven fact, that human life could be sustained on a vegetarian diet, provided the food contained the proper admixture of nitrogenous and non-nitrogenous ingredients. Hence it would be possible to approach with vegetable products the composition of a normal food, except in one ingredient, in which the animal superseded that of the vegetable nutrient principle, *viz.*, common salt.

One hears often, in reference to vegetarians, the remark: "What miserable beings they look; there seems to be no stamina in them". Now, I believe, that it is for want of common salt in their system; and if they would only forget the unscientific objection to this mineral food, and supply it to their organism in any other way, if they do not wish to take it with their meals, they would, I am convinced from practical experience, successfully answer the opponents among the omnivora.

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[1] Prof. Jacob Moleschott, *Kreislauf des Lebens*, "Antwort auf Liebig's *Chemische Briefe*," Vierte Auflage, Mainz, 1863, p. 101.

I remember some years ago an apostate from vegetarianism writing a maledictory article, in which he accused vegetarian food of having caused in his own person arteritis; but, from the symptoms he described, I think, that his ailment had its origin in a deficiency of salt in the system, which caused a semi-ossification of the walls of the arteries, and thus destroyed their elasticity—a phenomenon frequently met with in old age. This should remind elderly people not to forget their daily supply of salt in solution, to keep their cartilage supple, their arteries elastic, and their joints from getting stiff through semi-coagulation of the albumen in the synovia.

It may possibly be in the remembrance of many vegetarians, that some twenty years ago, I think, a Mr. Dornbush, a very strict vegetarian, died at the early age of about forty-two or forty-four years (from information I received), a martyr to his opinion about the inutility of common salt.

Let vegetarians admit common salt to their dietary—if not at their meals, so as not to vitiate or destroy their sensitive taste, then at least as advised above in a solution morning and evening—and the result will not only add to their healthy appearance, but will give them all the stimulating effect, which the carnivora claim for the animal diet.

"It was a valuable dust, which the ancients after cremation preserved in vases, and deposited in their tombs."[1]

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[1] Moleschott, *Kreislauf des Lebens*, p. 149.

CHAPTER XLIX.

PRACTICAL EXPERIENCE.

WERE I to record the grateful acknowledgments offered to me, during now more than twenty-five years, for the advice of taking a dose of common salt in solution once if not twice during the day, which advice I have imparted, whenever an opportunity offered itself—it would fill many pages ; but such a record sinks into insignificance beside the possibility, which every one possesses, of submitting the advice to a practical trial.

The thing is so easily carried out, and, it may truly be said, it costs nothing ; whereas it will save a considerable sum otherwise spent for drugs and doctors' fees.

The advice which I have proffered has in many instances been rewarded by information, which proved not only a support of my views, but is also of sufficient interest and so instructive that my task would not be completed, were I to omit to give an account of it. To this I will add extracts from other works, to fortify your —I hope—conviction, that the subject of our inquiry is of paramount importance, which no doubt your mind has perceived long before this.

In the preceding pages I have already referred to several cases in which signal benefit was derived from a liberal supply of common salt, so I will mention cursorily a few others.

Case of Rheumatism

A Mr. Albert S—— had been "doctored" for some (seven ?) years, without improving his bodily health. After the use of only the morning dose for several weeks, he found himself so much better—in fact he reported that he had never been so well in his life—that he became a great enthusiast, and himself attended to the salt solutions being prepared for all his children in the evening, to be in readiness for them in the morning.

Mr. Frederick H—— suffered from the result of a severe attack of a constitutional disease (rheumatism ?), which left him so powerless that he could not hold himself erect, and was unable to walk, except under great stress. He consulted, according to his statement, a number of physicians, but without relief. After four weeks' use of the salt solution he found himself strong enough to do "what he had despaired of ever doing again, *viz.*, walk across Regent's Park and ascend Primrose Hill".

A lady, after having herself benefited by it, used the solution among the pupils of her school, and reported after six months, that although the number of pupils had doubled, her chemist's bill had been reduced to one half, with a great improvement in the children's health. Among these latter was a child suffering from a strumous disposition, and her unhealthy condition was evidenced by pimples and pustules on the face. On the administration of the common salt, these pustular eruptions disappeared and the child's face indicated an improved state of health. When at home during the holidays, the father prohibited the child continuing the salt solution, declaring it absurd to think, that common salt could have this effect. As a consequence the pustulous state of the skin reappeared, and when after her return to school the ailment yielded to the salt, the father could not but admit the fact, and consented to the child continuing taking her morning dose; but whether he was convinced I have not been informed.

Among the parents who sent their children to St. John's College, Hurstpierpoint, in 1874, doubt was expressed about the wholesomeness of the drinking water at the college, in consequence of which the water was analysed and was found to be free from organic impurities, but to contain "some mineral substances, principally common salt, which gave it a peculiar flavour". The question arose, should the use of the water be discontinued and another source, from the chalk formation, be tapped? In course of a conversation I advised a friend to resist such a change, as no doubt he would find on inquiry, that the boys at the college enjoyed good health above the average. And this was confirmed by the medical officer "who has attended the boys for several years".

A gentleman, who joined an expedition to East Africa, acted upon my advice to forestall and prevent the tropical fever by never drinking any water, unless it contained some common salt; he acknowledged that he never felt better in his life. "This may be the result of the salt prescription, as, since I started, I have never tasted water without salt in it and never will again if I can help it, the salt makes it so much nicer." Writing to a friend at a later period, he "calls the salt notion a grand one".

A gentleman of the legal profession, who for years listened to my advice with a pitiful smile on his face, evidently (according to his remarks) at the narrow and limited view I took of the mysteries of the human body, and at the presumption on my part to try and supersede the acknowledged science and skill of *legitimate medicine*—was at last persuaded to give my suggestion a trial, and was forced to admit in a letter: "I shall have something to say to you respecting your admirable pamphlet on salt. I have *tried it for three months with results astonishing to myself*."

I will conclude these few instances of personal acknowledgments with repeating a remark frequently made to me about the effect of common salt on the system generally, after a fortnight's or three weeks' daily use, *viz.*, that it caused a marked increase in physical energy; and by ladies I have been repeatedly told, that it had improved their appetite, and that they could not enjoy their breakfast unless they had had their morning dose of salt and water.

Among the many accounts I received about the salutary effect of common salt on man and on the domestic animals, the following deserves a foremost place. It was given to me by a Mr. Wren (a descendant of Sir Christopher Wren), whom I met on his travels while he was on a visit to England, and with whose consent I connect his name with the following account, given to me about the year 1878 or 1880.

Mr. Wren's father owned a sheep station in New South Wales, situate on the shores of the Pacific, where the Biga River enters the ocean. On this station were employed some Australian aborigines who, from overfeeding, developed at times so gross and unhealthy a state of their system—in fact so morbid a condition of their blood—that the slightest scratch produced festering wounds of the skin. In this diseased state they disappeared, but returned after from two to four weeks' absence, fully restored to health.

Curiosity caused them to be followed, when it was discovered that they went down to the beach and prepared themselves, as best they could, a shelter in the caves or under the overhanging cliffs; obtained as food any of the wild roots they could find, and probably submitted to a kind of starvation diet. But what will interest us is the following: Where the Biga River enters the ocean, they dug a hollow in the sands of the shore, sufficiently near for the water of the river, where the plain and the salt water mixed, to filter into it; if the water proved too salt, they went a little higher up the river until the saline taste was to their liking; and this water they drank as medicine until their normal state of health was restored, when they returned to take up their previous occupation at the sheep station.

Mr. Wren further related the following facts: When "rot" affected the sheep, these latter were sold—sometimes a whole flock of several hundreds at a time—for a few pence per head, to men, who drove them away, but who, after several months, returned with them fully restored to health and in a good condition, reselling them at from six to eight shillings per sheep. On inquiry it was ascertained, that the sheep were driven into the interior, where—as already referred to above (see p. 29)—the old shores of a dried-up salt lake still produced a vegetation, containing a high percentage of sodium-chloride, called the "Salt-bush".

Eating this vegetation, and thus charging their system with common salt, the sheep were restored to health, driven back to the original owners, and sold at a price which fully paid for the time and trouble.

Query: Could not this have been effected without driving the flock into the interior?

Comparative physiology justifies us to apply, with more or less certainty to man, what has proved either beneficial or harmful to the physical well-being of the domesticated animals; and in this light the following experiments made by Boussingault, as reported by Liebig,[1] deserve a place here.

Dealing with the necessity of common salt for the animal organism, Liebig states:—

"The result of the excellent experiments of Boussingault is in this respect decisive, clear and intelligible. The addition of salt to fodder had no influence on the quantity of flesh, fat or milk, obtained from the animals; 'but,' says Boussingault, 'the salt appeared to have a favourable effect on the appearance and the quality of the stock. After the first fourteen days we observed no perceptible difference between the two lots (each of three oxen); but in the course of the month following, the difference was visible even to the unpractised eye. In the beasts of both lots the skin to the feel was fine and sound, but the hair in the oxen, which had got salt, was smooth and shining, that of the others was dull and erect. On prolonging this experiment, these signs became still more prominent.

"'In the animals of the second lot, after they had had no salt for a year, the hair was matted and the skin here and there was devoid of hair. Those of the first lot on the contrary retained the look of stall-kept beasts; their liveliness and frequent indications of the tendency to leap, contrasted strikingly with the heavy gait and the cold temperament observed in those of the second lot.'"

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[1] Liebig's *Letters*, pp. 408-409.

Commenting on this extract from Boussingault, Liebig says: "These experiments are most instructive. In the oxen which only had as much salt as was contained in their fodder, the quantity of salt *was insufficient for the secretory process.* There was wanting the means of transport for a number of substances which, out of the body, excite disgust; their whole frame, their blood, flesh and all the juices were loaded with these, for the external surface of the skin is a mirror of the state of the interior. The other oxen which daily had salt added to their food, remained healthy, even in the mode of life, to which they were confined, which corresponded but little to their nature, and with excess of food and deficient exercise. Their blood remained pure and well fitted for all the purposes of nutrition. In the salt they had a powerful means of resistance to external causes of disturbance to health, which in the actual circumstances was indispensable to them. The body of the others was, in regard to disease, like a fireplace heaped with the most inflammable fuel, which only requires a spark in order to burst into flame and to be consumed." And Liebig concludes his observations on these experiments with the sentence: "And the advantages attending its use can *hardly be estimated too highly*".

Every word of the above remarks of Baron von Liebig applies with equal force to human beings, and should be impressed upon every one's mind. Some of the sentences deserve, written in golden letters, a place in every household, beside, if not above, the scriptural text, as the health of the body deserves precedence to the care for the soul; for, *in corpore morbidus nulla mens sana.*

How easily such information, as conveyed in the above report of Boussingault, can be misunderstood and lead to deplorable results and wrong conclusions, is illustrated in a letter to *The Times* (27th Jan., 1880), in which Mr. Robert Heath warns against giving too much salt to cattle, and against mixing it with their food. He further relates :—

"During the cattle plague, I remember a letter from a member of Parliament, which appeared in your columns, stating, that he had given two to three ounces of salt every morning to his calves and that they had all died. I think any one accustomed to stock would agree, that such doses would kill the calves independently of any plague."

Against stupidity even the gods fight in vain (Schiller).

It must appear preposterous to give from 60 to 80 grams, and this perhaps in one dose with food, instead of about 10 grams during the day dissolved with water; or, as Mr. Heath very properly advises, "a separate box with soft salt or a lump of rock-salt, always kept within reach of stock. Nature will lead them to lick as much as may be useful to them."

And how effective it was found in "rot" was recorded by Mr. St. John Ackers at a meeting of the Gloucestershire Chamber of Agriculture, who said, he knew two or three owners of large flocks of sheep who had constantly done what had been recommended in *The Times*, *viz.*, place lumps of rock-salt about so that the sheep may lick them, and the flocks had been kept free from disease. He had also known cases in which the salt had been discontinued and "rot" had appeared, and on recurring to the use of salt it had disappeared (*The Times*, 2nd February, 1880).

Whenever failure has been the result, it is most probably owing to the fact that common salt has been looked upon as a medicine and a specific, to be offered to cattle and sheep, when the disease makes its appearance, instead of considering it as food, to be given regularly every day and independently of any other nutriment, either in solution or as a salt-lick.

Liebig[1] relates that "there are countries where salt must be given to animals to keep them alive". According to Warden, for example, in the northern districts of Brazil, domestic animals died, when they did not receive a fixed portion of salt or saline sand; and in a "Prize Essay on the Use of Salt," crowned by the Academy of Medicine of Brussels, Dr. Desaive remarks that "salt increases the fertility of the male and the tendency of the female to conceive, and doubles the power of nourishing the fœtus. During the period of suckling, the salt, given to the mother, renders the sucking animal stronger and the milk more abundant and more nutritious."

"Experience seems to confirm," says Schleiden,[2] "that a liberal use of salt protects the animals against disease. This idea was entertained and acted upon as long ago as 350 years B.C. by the Ardiaens in Illyria, who thus believed in preventing epidemic diseases among their herds of domestic animals. In France it is asserted that of a certain number of sheep, feeding off one and the same land, 50 per cent. died without salt, and only 1 per cent. if salt was given to them."

A fact, well deserving of notice, is that grass lands, exposed to the sea-spray, are not only distinguished for their excellent grass crops, but as a consequence also for the cattle reared on them. And this applies to a great extent to meadows surrounding salt works, especially those situated to the leeward of the prevailing winds.

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[1] Liebig's *Letters*, p. 414.

[2] Schleiden, p. 205.

What man, with all his intellectual superiority, has failed to perceive, has been taught him by the brute-creation, and by inferior races of mankind, of which the records of travellers give ample proof. So we read in Mungo Park's *Travels* :—[1]

" I requested something to eat, and a little boiled corn with salt and water was sent me in a wooden bowl ;" and again, " Ali sent me for supper some kouskous and salt and water," is related on more than one occasion.

He further records : ". . . in the interior countries, the greatest of all luxuries is salt. It would appear strange to a European to see a child suck a piece of rock-salt as if it were sugar . . . ; the poorer class of the inhabitants are so very rarely indulged with this precious article, that to say : a man eats salt with his victuals, is the same as saying, he is a rich man."

Recording his observations about the inhabitants of Central Africa, Lieutenant Stairs, one of Stanley's companions, relates :[2] " The three articles that every African holds nearest and dearest to his heart are—meat, salt and oil or fat. He would sell everything he possessed in order to obtain these ; and he is a rich man indeed in many countries, who can lick his lump of rock-salt as many as five or six times a day. It is far too precious to him to crush it into powder and mix it up with his food ; he prefers to make it go farther, so that he can think fondly over it, and so undoes his bundle, takes out his piece of salt, touches it with the tip of his tongue, and returns it carefully to its resting-place. It is then jealously guarded, and lashed with bits of string to his person."

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[1] Mungo Park's *Travels*. Cassell's *National Library*, i., pp. 118, 119 and 132 ; and ii., p. 91.

[2] Lieut. W. G. Stairs, R.E., " From the Albert Nyanza to the Indian Ocean," *Nineteenth Century*, June, 1891.

What a glorious hygienic achievement it would be, could our children be accustomed to salt-licking, instead of the pernicious sucking of lollipops and sweets (see "Diphtheria" and "Infants").

And an African's hospitality finds its highest expression in his invitation: "Come and eat with us to-day, we are going to have salt for dinner".[1]

The Portuguese travellers Capello and Ivens[2] also pointed out, with what ravenous delight salt is acquired by the natives of South-western Africa: "Often and often have we had occasion to observe the eagerness, with which the natives would rush forward to take a pinch of salt, we offered them in the palm of the hand, and which they would take up with the tongue like a dog to the last particle; and it was quite a sight, when Capulca, in his cooking, let any fall on the ground, to see the boys and girls pushing and scrambling to lick it up".

Our knowledge of the necessity of common salt for the human economy will cause us not to be surprised to hear, that, as in Africa, so we find on the islands of the Pacific, the inhabitants in the habit of either drinking salt-water or cooking their food in sea-water. Schleiden mentions, that the Melanesians on Kunaje—living chiefly on vegetable food—drink in the morning a pint of sea-water. In Tahiti and in New Zealand the drinking of sea-water, with solid food, is frequently met with; and in Tahiti, Tonga and Samoa, fish were eaten after being dipped in sea-water.[1] He himself, when visiting Heligoland, saw the fishermen, before returning to the shore, fill a kettle with clear sea-water, in which, after landing, the fish they had caught, were boiled; and, adds Prof. Schleiden, he never tasted more delicate fish.

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[1] Winwood Reade, *Martyrdom of Man*, p. 285.

[2] Capello and Ivens, *From Benguella to Yacca*, i., p. 285.

The salutary effect, which common salt can have on the character of our food and drink, is illustrated by the following: The Intoxicating Liquor Act of 1872 declared salt among the deleterious ingredients "not to be mixed with any intoxicating liquor sold to the public". But it was found, that beer brewed without salt would not keep, and was in many instances returned to the brewers as unpalatable. An analysis of the water used in brewing Bass' and Allsopp's celebrated ales was made, when it was proved, that the best ale contained more than forty grains of salt per gallon (that is, 0·57 part of salt in 1000 of beer; or about one-tenth the proportion contained in the blood). Of course the Commissioners of Inland Revenue have had to give in, and allow the employment of fifty grains of salt per gallon. (Copied from *The Lancet* in *The Times*, 31st December, 1872, or 1st January, 1873.) It is preposterous to talk about exciting thirst with that small proportion of salt.

The Temple of Health, a popular hygienic periodical of San Diego, California, refers to sea-water as a medicine in the following words: "As a matter of fact, one of the most beneficial features of a sea-bath is the salt-water inadvertently swallowed by bathers. It is a wonderful tonic for the liver, stomach and kidneys. In many cases it will cure biliousness, when all drug preparations have failed. . . . You never see an old sailor who is bilious, dyspeptic, or a victim of insomnia, and why? For the simple reason, that an ocean of good medicine is spread all about his ship," etc.

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[1] Schleiden (from Waitz, *Natur-völker*), p. 83.

It should be mentioned here, that at last the Admiralty has decided to add common salt to the dietary of the crews of Her Majesty's ships, in the proportion of an ounce per man every four days. This would appear a little more than half the quantity which most physiologists would consider necessary; still it is a step in the right direction, and should result in a general improvement in the health of our noble seamen.

Even the Chinese can teach us something about the beneficial use of common salt. In a work entitled *The Inner Art of Prolonging Life*, the author warns against an excess of tea drinking, since too much of it causes stagnation in the kidneys, as also an enfeeblement of the lower extremities. To prevent this it is advised, to add some salt to the tea (which, as is well known, is taken in China without sugar and milk).

This advice should be taken to heart by so many people, who ruin their digestion first, and next their constitution, by the pernicious habit of a hot strong cup of tea on an empty stomach in the morning; and I would appeal to them to follow this advice, with the earnest intention of gradually increasing the pinch of salt, in proportion as the tea is made weaker. The gradual change will not subject them to any hardship or sacrifice, but will imperceptibly improve their digestion and general state of health, unless the former is already past cure.

I must not omit to repeat a statement, which has gone the round of the journals, but which, however probable it is in accordance with the contents of the preceding pages, must stand on its own merits; that, *viz.*, Men attending the pans in salt-works, are never known to have cholera, small-pox, scarlet fever or influenza. It has not been contradicted, but has every probability of its contention being correct.

This subject cannot be better concluded than by an extract from Sir Francis Head's *Bubbles from the Brunnens of Nassau*, illustrative of the medicinal effect of common salt on the human organism. It refers to Schlangenbad (serpent's bath), a watering-place in the Taunus Hills.

The waters contain in 1000 parts 1·325 of sodium-chloride, as chief ingredient, with insignificant portions of other salts. The baths are said to have a sedative and a beautifying influence on the skin, rendering it soft and rejuvenated.

Sir Francis relates:[1] "In the history of the little duchy of Nassau, the discovery of this spring forms a story full of innocence and simplicity. Once upon a time there was a heifer, with which everything in nature seemed to disagree. The more she ate the thinner she grew; the more her mother licked her hide, the rougher and the more staring was her coat. Not a fly in the forest would bite her; never was she seen to chew the cud, but, hide-bound and melancholy, her hips seemed actually to be protruding from her skin.

"What was the matter with her?—no one knew; what could cure her?—no one could divine. In short, deserted by her master and her species, she was, as the faculty would term it, given over. In a few weeks, however, she suddenly reappeared among the herd with ribs

[1] Health Primers, *Baths and Bathing*, London, 1879, pp. 61-62.

covered with flesh, eyes like a deer, and skin sleek as a mole's, breath sweetly smelling of milk, saliva hanging in ringlets from her jaw. Every day seemed to re-establish her health, and the phenomenon was so striking, that the herdsman, feeling induced to watch her, discovered that regularly every evening she wormed her way in secret into the forest, until she reached an unknown spring of water, from which having refreshed herself, she quietly returned to the valley.

" This trifling circumstance, scarcely known, was almost forgotten by the peasant, when a young Nassau lady began to show exactly the same incomprehensible symptoms as the heifer. Mother, sisters, friends, father, all tried to cure her, but in vain, and the physician had actually

Taken his leave with sighs and sorrow
Despairing of his fee to-morrow,

when the herdsman, happening to hear of her case, prevailed upon her at last, to try the heifer's secret remedy. She did so, and in a very short time, to the utter astonishment of her friends, she became one of the stoutest and roundest young women in the duchy."

Without accepting the above story in its literal sense, we cannot do otherwise than see in it a statement of certain facts relative to the beneficial effect of the saline waters of Schlangenbad, embellished in the frame of a pretty tale ; for the possibility of such a " cure " finds a support in everyday practical experience.

CHAPTER L.

SALT IS NO PANACEA.

It is excusable that—after having listened to the praises sung in favour of common salt as a principal factor for the health and physical well-being of man and the domestic animals—you should yield to the idea of considering it a panacea for "all the ills that flesh is heir to"; and it is only fair to warn you against such a rash conclusion.

Nothing would do so much harm as to allow such an inference to get possession of the public mind; and on the strength of this to induce people to give way to abuses and self-indulgences with the expectation, that a dose of salt and water as a "physic" will correct the harm that has been done. There are equally important factors, such as, above all, moderation in eating and proper selection of food, judicious and systematic physical exercise (which latter alone deserves a special popular treatise), free activity of the skin and a normal action of all our organs, etc., to ensure the maintenance of our health; and the farther we inquire into this subject the nearer we shall approach the knowledge, which will designate disease as a crime.

Look at the glutton, who surfeits himself at an aldermanic feast; stuffs into his stomach any substance most artistically and enticingly prepared; washing all down with two or three kinds of wine, finishing with "a wee drap o' whisky to keep it a' doon," and indulges himself not only this, but again next week, if not oftener, until his system, which has had strength enough to bear it so long, at last breaks down ; and the, not Australian aborigine, but highly intellectual member of the highest intellectual community, is thrown on his sick bed, and then asks us to pity him in his illness, which, he pleads, came upon him as an undeserved affliction.

A regular use of salt and water in one, two or three doses during the day may assist him ; but he requires reformation in his mode of living.

Notice again the children of the poor, the truly innocent sufferers, who are the victims of cheap, that is, bad and often half-decomposed food ; who ail through confinement, mostly in dwellings, too wretched for the poorest beast, much more so for human beings, without light or air, and without a decent place in which to exercise their limbs, so necessary for their healthy growth and proper physical development.

Yes, salt will help here to avoid the further putrefaction of their food and to protect their organism against the infection, which such unwholesome state of existence must naturally engender ; it is however no panacea.

But how can disease in this case be designated a crime? Who committed it? Who? Listen to the glorious news that should make the heart of every one rejoice : £105,000,000 are to be spent upon the nation ; but how much for alleviating the poor in their truly undeserved sufferings from disease? Or go into the west end of London and see the palaces belonging to the wealthy, which cost perhaps £500,000 each, and are probably occupied only a few weeks during the year, standing empty the rest of the time except for a retinue of servants, who pass their time in idleness. Or accept the invitation to a drawing-room meeting and listen to the report of a city missionary, who soothes the conscience of his listeners by relating, into how many hovels he has brought the glad tidings of a loving, compassionate God. Who causes here the illness and commits the crime? Answer: a Christian Society, which boasts of being a leader in the van of civilisation, and gives a stone where the poor have asked for bread.

Again, observe the sad calamities which from time to time befall different communities in the shape of epidemic diseases.

Take as an example Maidstone, suffering from typhoid fever; or notice the sad spectacle of Bombay being decimated by the bubonic plague. There medical science and art proves helpless, and the plain simple truth is, that the profession is impotent against the ravages of these diseases. Instead of applying their superior knowledge to an inquiry into the cause of the natural immunity; to ascertain what it is that protects most persons against the attack—what makes them insusceptible to the poison, and others less so, that they only suffer in a slight degree—and then to apply this acquired knowledge to the protection of those, who may have a predisposition for the disease; instead of this: they rake up and seek in every nook and corner where to find fault with everything else, buildings, drains, water supply, etc., but not their own shortcomings, while the disease germ mocks all their interference, and seeks its victims among the opulent as well as among the poor.

But above all, with the full admission of their powerlessness to influence the developed case or to prevent the attack, then still to oppose any attempt of solving the above question, although suggested by and based upon physiological, pathological and general scientific facts, *is a crime;* and the death of many human beings, that might have been saved had the advice been listened to and given a thorough practical trial, must fall on the conscience of those, who are responsible for such a refusal.

Salt is no panacea; but it deserves a foremost place among the factors, which ensure the maintenance of our health and bodily well-being.

CHAPTER LI.

WHAT SHOULD BE DONE.

CONSIDERING the weighty interest, which attaches to the question of the utility and necessity of common salt for the human organism, and my statement that the subject has engaged my attention at intervals during twenty-six years, you may very naturally ask the reason, why I have not taken energetic steps at an earlier period to make the results of my inquiry known.

I need not enumerate here the several attempts I have made since April, 1871, to gain the public ear, and to appeal for the adoption of my advice. A little reflection will indicate the difficulties, which are always met with, when ignorance, prejudice and self-interest are opposed to any proposition, however important its issue may be.

The general public are absolutely ignorant on the question, and medical men have paid too little attention to it; labouring in fact under an entire misapprehension of the point at issue—*by assuming a rigorous permanency in the proportionate amount of common salt in the blood and disregarding the comparatively enormous fluctuation in the total quantity of salt in the system generally*. And, although not in a position to give definite information to the laity, professors of the healing art, to whom the general public have to look for such information, resent any attempt made outside the profession to instruct the rest of mankind; whether such resentment is instigated by a fear, that the nimbus of their social and scientific position, or their influence and hold upon the general public will suffer, must be left an open question.

The application of common salt in individual cases or in a family for the prevention of disease is so simple a matter that it lies mostly outside the influence of the family medical adviser; but when the question arises of protecting a whole community against, or of checking the spread of, an epidemic, of making an appeal to a whole populace for the application of this prophylactic means—such steps are never undertaken by the municipal authorities on the timid plea, that this is a question, which must be submitted to the decision of the Medical Officer of Health.

We have, however, yet to meet the member of the profession, who will consider that the halo of medical science will *not* be destroyed or disturbed by his consent to the employment of common salt. But until such broad-minded and unbiassed man is found, people must die, since medical art is helpless to cure and has no other means to prevent the disease than those—extra-corporeal—now employed at Bombay, inciting the natives to rebellion, and affording on the whole a distressing spectacle.

The latest evidence of this is given in an article in the *Nineteenth Century* (June, 1898), entitled: "Fighting the Bubonic Plague in India," by Miss K. Marion Hunter, late Medical Officer, Poona.

The writer declares that "the lack of sanitary arrangements has much to do with the difficulty of checking an epidemic.

"With the apparent end of the epidemic in June, 1897, the system of house to house visitation was allowed to lapse, and *corpse inspection* by medical officers took its place. That *this was insufficient*, the rapid strides made by the disease in the early autumn months showed."

Corpse inspection—that is, inspection of the dead by medical officers—was insufficient to check and suppress the disease. What an insult to our understanding, to ask us—which tacitly is the object of the writer—to accept such absurdity as medical science. And with house to house visitation the disease took its fatal course despite the army of doctors.

Miss Hunter speaks of "agencies employed in checking the disease; the segregation camp and disinfection of clothing, etc.," all measures outside the body; and she complains that "the efforts to stamp out the disease having been so comparatively unsuccessful, one is inclined to think more radical measures should be adopted. The suggestion to burn down insanitary areas . . . may yet have to be seriously considered." Yes; direct your attention to everything and every part outside the human body, but not to the cause of the insusceptibility of the greater number of people who escape the disorder through a simple natural immunity.

A most important statement is made in the report; it is to the effect that "Convalescence was slow, and unfortunately *one attack is not protective against a second*". This is a plain admission of the inutility of the serum treatment for prophylactic purposes; and again the question is forced upon us, whether the simple injection of common salt solution (which, as we have learned, forms always the substance of every serum) will not be equally if not more efficient in the treatment of the developed case, and the liberal supply of salt to the body, be the best prophylactic against an attack, than all the measures now adopted.

Miss Hunter further informs us, that "the most common cause of death is heart failure, as a result of the high temperature". That high temperature in itself is not the cause of heart failure we have seen when dealing with sunstroke; and surely we need not seek for a cause in face of the utter destruction of the blood in this disease, which would point to common salt as the chief agent for the prevention of the plague.

What, then, is to be done to demonstrate the value of common salt as a prophylactic for the prevention of zymotic diseases, and thus to place the medical profession in the wrong in the continued opposition to its trial and adoption?

No reasoning powers—to repeat what I stated on a previous occasion—nor scientific proofs, not even the single or repeated instances of the prevention and cure of individual cases, can suffice to establish the incontestable efficacy of salt as a prophylactic; to prove this it is necessary to institute a systematic and methodical experiment under special conditions, so that there remains no doubt about the result.

It would be a futile attempt were this knowledge, of the protection afforded by common salt, diffused promiscuously, without method and without circumspection. To arrive at an indisputable conclusion, and so ensure the general application of this simple means, nothing less than an appeal on the part of a government or a municipality, addressed to the inhabitants of a town or district, in which an epidemic has broken out, will suffice to make sure of the general application of the remedy, and thus to stamp out the epidemic in course of a week or two.

In the case of a prison, an asylum or other similar institution, it cannot be very difficult to give the necessary instructions to the inmates; to watch over the carrying out of the advice, and to control the result. This latter, if favourable, would justify and encourage the more extensive attempt of meeting an epidemic in a city or larger district, and inviting the inhabitants to the adoption of common salt, by wall- and handbills, which should be distributed over the entire locality within a few hours, to ensure the general simultaneous application of the prophylactic remedy, and thus make the result all the more striking and convincing.

Is there, however, a medical officer of health who will be unprejudiced, bold and magnanimous enough to advise a government or a municipality to act upon the above advice? I doubt it.

It will require the formation of an association of "laymen," who, convinced of the reasonableness and the scientific basis of the above recommendation, would overcome medical indifference and opposition, and act either with or without the consent or conjunction of the sanitary authorities. *No one can have any scientific or social reasons for opposing such an undertaking, unless it were a fiendish desire to prevent the check to the spread of an epidemic from personal or professional motives.*

Should, however, private interest impede or be indifferent to any such experiment, which promises to be conducive to an improved state of health of the community, surely *it would be the duty of the Government to act, to institute an inquiry and order the necessary measures to be taken for establishing the truth or falsehood of the asserted prophylactic powers of sodium-chloride.*

And what an opportunity is offered to the British

Salt water bathing results
– dissolves organic impurities with

Government in this direction. Considering alone our Army in India, in the light of the waste of human life through death, and of social energy through disease, when at times one half of the soldiers are in hospital; would the Government not be liable to impeachment for the indifference shown towards a prophylactic means, which would lessen the ailments of the liver, the susceptibility to cholera and to so-called sunstroke, and which would thus save the finances of the country and the pockets of the tax-payers?

Next we shall find the inhabitants of India benefiting to an unheard extent; but here we meet with another obstacle—the salt tax, which, as already stated, exercises a great influence on the health of the Indian populace; and the repeal of which may well form one of the objects of the above suggested association.

Lastly, among the subjects that deserve our attention for an active interference, is the establishment of public salt-water baths for the poor. We have ascertained the great advantage offered by salt- as compared with plain-water for bathing purposes. The salt not only dissolves the organic impurities of the skin, but it also by diosmosis deprives the body of superfluous moisture, and itself enters the circulation through the pores, through which the perspiration escapes.

A warm salt-water bath would thus be the greatest boon to the poor. In a hot bath, the bather would lay in a store of heat to withstand the cold weather (as the people do in Japan); he would lose superfluous moisture, and thus become hardened against colds and change of temperature (see p. 192); and lastly he would absorb common salt into his circulation with all the benefit accruing to its presence in the system. By means of salt-water baths we should prevent disease, and correct betimes any slight disorder, which, without this preventative application and by further neglect, would drive the sufferer into the hospital with the loss of his time, and to cause expenses a hundredfold, as compared with the cost of a bath.

Build salt-water baths to be enjoyed by the poor at a nominal price ; not only will you offer them the enjoyment of cleanliness, but you will keep out of the hospitals most cases of internal disease, and thus give greater facility for the attendance to cases of accident and save money.

On several occasions has the question of bringing sea-water to London been ventilated in the Press, in books and by scientific lecturers. That this boon will ultimately be achieved, I do not doubt, when once the incomparable importance of common salt to human life and well-being has taken possession of the public mind. In the meantime we can meet the requirements by building new or adapting old baths, and by using common salt for the purpose.

Considering the loss of time and money by illness—estimated for London alone at several millions a year—the community at large would be the gainer by such establishments.

" To those who are past the meridian of life, have dry skins, and begin to be emaciated "—writes Darwin—" the warm bath for half an hour, twice a week, I believe to be eminently serviceable in retarding the advance of age."

Hufeland speaks in the following terms of sea-bathing, which, " besides its great healing power in cases of disease, may be employed by those who are perfectly well for strengthening and preserving health. In this respect it may be compared to bodily exercise, which can remove diseases otherwise incurable."[1]

Would but an Agrippa arise and give to London the *one hundred and seventy public baths*, which the original benefactor did to Rome, when—as Pliny tells us—*the common people used no other kind or system of medicine.*[2]

Instead, therefore, of maintaining huge hospitals at an enormous cost, and wasting social energy by allowing internal ailments to cripple the poor, rather let us prevent disease, and at the same time promote bodily cleanliness by establishing public *warm salt-water baths*, which could be aided in their hygienic object by *gymnasia for physical exercise.*

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[1] Erasmus Wilson, *Healthy Skin*, 3rd ed., London, 1849, pp. 145-146.

[2] Dr. Brochard, *Sea-Bathing and Sea-Air*, London, 1865, p. 3.

CHAPTER LII.

SALT AND THE DOCTORS.

DURING the reading of the preceding pages, the question must have occurred to you more than once, how it can be explained, that this subject of the beneficial influence, which common salt exercises on our physical well-being, has been so much neglected by the general body of medical men.

It cannot be owing to the fact that the "Doctors" leave the "Laity" to pick up and gain information on the subject as opportunity offers, although on any question referring to the human body, we are met benignantly by the supercilious assertion, that we are incapable of forming an opinion upon such matters. Nor can it arise from a want of any desire on the part of the faculty to exercise its superior knowledge for our benefit, since in the matters of house drainage, cesspools, water supply, and even in the "Art of Plumbing," medical men step forth to be our hygienic guardians. The more remarkable is therefore the silence on the use and necessity of common salt for our health.

It must be a misjudgment—an error (*errare humanum est*); for even the cleverest can err, and Liebig may well say :—[1]

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[1] Liebig, *Chemistry and Physics in Relation to Physiology and Pathology*, London, 1846, pp. 4 and 5.

"Innumerable instances testify, that even the most accurate observers of their age have regarded certain facts or representations as impossible, simply because their power of comprehension was unable to receive them; while their successors have not only comprehended them, but, what is far more, have universally received them as incontestable truths".

Such, we shall find, will be the case in the question before us. The generality of medical practitioners have shown an utter disregard of, if not an opposition to, the employment of common salt for prophylactic, and certainly for curative, purposes; and I think the reasons are evident:—

(1) Because common salt—considered as a mere condiment, always or mostly always used in every household—cannot, *so it is assumed*, have any therapeutic effect on the human organism in the light, in which medicines are said to act, in their specific power against definite forms of disease.

(2) Because the fluctuations of the quantity of salt in the system have been undervalued and neglected by medical men.

Physiologists—with few exceptions—have merely estimated the proportion in the blood, and only referred incidentally to the amount otherwise stored in the system. It has been overlooked that the former—the salt in the blood—when reduced through insufficient supply to a minimum, is limited in its action by its fixed relation to the blood corpuscles, and can only be set free for any other office by the more or less extensive destruction of the latter.

Under such conditions, the functions of the various organs, which depend upon the presence of free sodium-chloride—such as the formation and secretion of bile, the excretion of urea and uric acid, the protection of synovia in the joints from coagulation, etc.—must naturally be impaired, and disease in various forms is the result.

In order to cure the disease—to re-establish "the harmony of the organs" (Virchow)—to correct the "deviation from the healthy state" (Galen)—the last thing which a rational mind would suggest, would be, to resort to the most heterogeneous, and often highly poisonous substances; and well may Prof. Beneke admonish his medical brethren, when treating of the disturbance in the circulation of the inorganic constituents of the human body, in the following words:—[1]

"They"—the generality of practitioners—"work with the most powerful agents in the form of medicine; with iodine, arsenic, mercury, quinine and a host of others; but the fate of the organism, so far as it depends on its integrating inorganic constituents, is left to kind nature, without the least reflection, that with all its benevolence, nature is limited in its action by one or the other condition; and that the most rational method of curing disease is employed by removing these conditions; in our case, *by restoring the inorganic ingredients to their normal proportions.*"

Let me hence appeal to you, to be guided in your acceptance of my advice by your own judgment.

Your own trial and experiment will prove to you how far I am right or wrong in my advice; and if you, as I know you will, experience the benefit from the judicious use of common salt, as thousands have done already, I shall find your voice raised in support of my contention : for a practical trial on a sufficiently extensive scale (in the case of an epidemic disease), and otherwise for the general application of common salt for the maintenance of health and the prevention of disease.

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[1] Beneke, *Gr. d. Path. d. St.*, p. 320. A work which bears on every page the impress of the observing and thinking physiologist.

CHAPTER LIII.

CONCLUDING REMARKS.

WHEN looking back upon the contents of the preceding pages, you may have the natural desire of rendering to yourself an account of what you wish to recollect, in order that you may derive the full benefit from the knowledge imparted and from the advice offered to you. Let us see how we can condense the salient points into a few precise sentences, which can easily be impressed upon our memory.

Common salt is a never-failing component part of the animal organism; it is absolutely necessary for the growth and the continued existence of the human body, and cannot be replaced by any other substance; to abstain from its use absolutely, leads to disease and death.

It enters into and beneficially influences the functions of most, and this the most vital organs.

It protects the blood corpuscles from destruction, and maintains them in an efficient condition for their important office, on which the life of the human body depends, *viz.*, the supply of oxygen to all the tissues, without which death or disease of the entire, or of part of the organism is the result. It thus prevents many of the fatal diseases, such as heart failure, syncope, apoplexy, paralysis, and a number of local and constitutional ailments.

It assists in the formation of new red blood corpuscles, and thus prevents scrofula, anæmia and chlorosis, etc.

It contributes by its interchange with other inorganic ingredients to the formation of new tissue cells.

It keeps the albumen of the blood plasma and of the lymph in a soluble condition, and prevents the abnormal coagulation of fibrin ; it is thus a prophylactic against rheumatism, gout, dropsy, diphtheria and other forms of disease.

It protects the nervous tissue against a too watery state of the blood ; it thus prevents influenza.

It abstracts water from the muscles and thus impedes the general enfeeblement of the system.

It promotes the constant flow of the various fluids through the tissues. When this flow ceases, then life becomes extinct. It is the office of common salt to intensify and regulate this flow, and thus to maintain our vitality.

It furnishes the principal ingredient for the formation of hydrochloric acid in our gastric secretion, upon which the organic stability and disease-resisting power of our tissues generally depend. It thus imparts immunity against the various infectious disorders.

It is the principal agent in the formation and the secretion of bile ; and thus it acts prophylactically in the prevention of a host of disorders, among them the many forms of fevers, and of those diseases which are peculiar to Europeans in the tropics.

It is the medium for the expulsion out of the system of the effete, used-up nitrogenous (more or less poisonous) compounds by way of the kidneys ; and—supplied to the organism in solution, *i.e.*, in company with water—it passes through the body as the best and most natural purifier of the blood.

We need but translate the information here given, from a positive into a negative form, to understand the harm, which may and does result from the abstinence from—and from an insufficient supply of—sodium-chloride to the organism.

With regard to the method of supplying the salt to our body, we may state the following:—

The salt taken with food should be used in such proportion only, as is required to make the food tasty, before any condiments are added—should this be considered necessary.

Whenever possible or convenient, the best means of absorbing salt into our system is the warm salt-water bath, of a density of about 2 to 2½ per cent. (¼ lb. of salt per gallon of water—or approaching this as far as means will permit). Children especially delight in this procedure, and enjoy playing in the bath.

The principal supply of salt should or must be in solution. For the ordinary daily supply, in a normal state of health, the density of the mixture should be such, that the latter *tastes pleasant;* this is about the proportion of one part of salt in about 100 to 150 parts of water. as much as will lie on a shilling [illegible]

During an epidemic, or during continuous hot weather, or in the tropics, the quantity of salt taken in twenty-four hours should at least be such that, if dissolved in all the liquid imbibed during the same period, it would result in a salt density of about, or a little under, 1 per cent. For example: if the total volume of liquid—drunk in one form or another, as tea, coffee, aerated or plain water, or taken as soup—amounts during the day to, let us say, 2 quarts (or 2370 grams), then the common salt taken should amount to about 18 to 20 grams, that is, not quite $\frac{3}{4}$ of an ounce.

But every one very soon finds out for himself the best mixture to suit his taste, and will be guided by the state of his system, how to modify or regulate the quantity and the proportion.

Let me recall to your memory what was stated above, *viz.*, that you may take too much salt at one time, but you cannot surcharge the system; the kidneys expel whatever superfluous quantity is present in the body. It is this wonderful function of the kidneys, which gives to common salt its great and unsurpassed benefit for our organism; *there is established a circulation of salt through the human body* which eliminates the used-up matter, and thus frees the body from morbid substances, which, if remaining, would be the cause of various forms of disease.

I cannot do better than close this chapter with the almost inspiriting remarks of Prof. Beneke, in relation to the general influence of common salt on the life of the organism. He says: "This undoubted effect, which the internal use of the mineral waters (containing sodium-chloride) or the simple solution of common salt exercises in many rheumatic joint affections, in cases of scrofula, or in cases of exhaustion of vital energy, etc., rests most essentially on the influence of common salt on the transformation of albumen, and on the augmented flow of the juices in the organism.

"And this influence does not react detrimentally on the blood corpuscles, as practical experience has shown. On the contrary, the altered conditions in the constituents of the blood appear to act rather favourably on their formation and their life, since with the consumption of common salt we frequently notice how a pale complexion is changed into a healthier colour.

"As the result of a prolonged use of common salt, we achieve what the older physicians designated as a 'dilution of the blood,' and for which the waters of Wiesbaden, Homburg, Kissingen, Kreuznach, Nauheim, etc., were recommended. Again, I should like to mention, how frequently it is perfectly useless for many patients, to resort to such costly, natural and artificial mineral wells" (Heil-quellen), "since it is in most instances quite possible to obtain the desired effect by a simple daily supply of a cold or warm common salt solution of a suitable concentration (at most not more than 4 grams to half a litre of water)," *i.e.*, 1 part of salt to 125 parts of water.

"Excellent results can often be arrived at by so simple a remedy; and I recall to my memory with pleasure a number of older patients who, tormented by rheumatic gouty affections of the joints, highly prized their salt-water, and since its use have ceased the visits to the watering-places, whilst complaining more about everything, than their age."

We may well join him in his exclamation:—

"*What a series of physiological processes, most significant for the maintenance of our life, are connected in a more or less high degree with the presence of common salt, which substance is mostly held in a low estimation*".[1]

It does not require another single word, after the verdict of such an experienced and unprejudiced authority; and I have no doubt that every one, who is not hopelessly enamoured with "legitimate medicine," and who is thus free and unbiassed to make for himself a trial of this grand gift of nature, will join me in declaring, *that we have a powerful factor for the maintenance of our health and for the prevention of disease in common salt.*

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[1] Beneke, *Gr. d. Path. d. St.*, pp. 325-326.

APPENDIX.

MEDICAL SCIENCE AND ART IN RELATION TO THE ILLNESS OF H.R.H. THE PRINCE OF WALES, 1871-2.

When in 1871 the Prince of Wales was struck down with typhoid fever, we learn from *The British Medical Journal*[1] what medical art is at the bedside of a patient suffering from that disorder:—

"It is a comprehending, noting and defining the course" —of the disease—"and its stages, and interpreting the precise degree and incidence of the inner development of the process, and a measuring its effects" (that is: comprehending, noting, defining, interpreting and measuring) "that the great triumph of modern medicine consists of. It has attained to the perception of the general laws, governing the evolution of a disease and underlying the production of symptoms. . . . It may be a very troublesome symptom and yet an extremely useful, or quite essential and inevitable corollary of the fever process; not to be struck at by this remedy or the other, as the quack and the goodies and the followers of the rule of thumb would still have us do.

"And so in the Prince's disease, while brain and eye, finger and ear, were always on the watch to test by temperature, by pulse, by inspection and by auscultation, what was the stage, what the course, and what the deviation of the fever process, the *great teachings of modern medicine in its highest philosophy* were strictly held in view. . . . The most accurate and careful determination of essential and local conditions has been invoked, to determine from hour to hour, what could be done to help the patient in passing through the process; the proved, known, simple and adequate powers of medicine have been employed in this sense, and *with the certainty and regularity of effect, to which medicine in this respect has now attained*."

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[1] *The Times*, 12th Jan., 1872.

Who would not go into ecstasies over this declamation, and in admiration of this dazzling aspect of "modern medicine in its highest philosophy," go on his knees to worship this achievement of the human intellect, were it not that—in all sober earnestness—we know this harangue is but empty nauseous rhetoric?

It finds its explanation and only excuse in the delirious joy that the Prince's constitution won the battle with the disease; and whilst joining in gratitude that the life of the Royal patient has been spared, we must protest against medicine being exalted in a manner, which is belied by facts, and which can have no other effect than to lower it in the eyes of all sensible educated persons—both medical and non-medical.

In accord with such hysterical exuberance is the side thrust which was dealt out to all the "quacks and goodies," who, out of loyal concern for the life of the heir-apparent, tendered their experience and offered their advice to the medical attendants of His Royal Highness; there is certainly nothing noble in such a rebuke.

Enthusiastic (as the result of its good effect in my own case in October, 1871) about the application of sodium-chloride, I was naturally induced to make an appeal for its trial to (then) Dr. W. Gull, in a letter dated 12th December, 1871, believing in my simplicity that any medical man would gladly hear of a means which, on scientific grounds, promised some good. I, of course, did not know medical etiquette and good manners, and became aware of my quackery when

I read in *The Times* of 25th December the following admonition :—

"It is not a little remarkable that the crowd of well-meaning and loyal persons, who have throughout this trying illness overwhelmed the physicians with letters and telegrams, suggesting every known remedy, have not ceased to give advice. . . . It is right to state, and indeed I have authority to state" (why was this necessary?) "that the recognised resources of medicine have proved equal to all emergencies of the case; that during the course of the disease no other modes of treatment have been employed than those with which all regularly educated physicians are acquainted."

The whole explanatory reproof occupied half a column of *The Times.* It is evident that some "goody-goody" made an attempt of wresting the palm from the gentlemen, who certainly deserve every acknowledgment for the days of anxiety which they spent at the bedside of the Royal patient. But why this remonstrance? We are almost reminded of a certain fable.

If medical science and art is so sure of the "certainty and regularity of effect to which medicine has now attained," why was not advantage taken of it during the typhoid epidemics at Worthing and at Maidstone? But the whole subject tells its own tale—the *un*certainty and the *un*reliability of medicine; and I point to this fact to justify a demand for a trial of a prophylactic (and probably also curative) means, which gives every promise, on scientific grounds, of success.

CASES OF SUDDEN DEATH,

here cited not by any means as a complete record, but as a few instances, which occurred during the last year or two:—

1.—H.R.H. the Duchess of Teck: "Although everything that was possible was done, she gradually sank and died . . . failure of the heart's action being the immediate cause" (*Times*, 28th Oct., 1897).

2.—Mr. Justice Cave died from the effects of a paralytic seizure (*Times*, 8th Sept., 1897).

3.—Sir Frank Lockwood. The actual cause of death is certified to be heart failure as the result of influenza (*Times*, 20th Dec., 1897).

4.—Colonel North was found dead on the floor of his office. His collar and tie were unfastened; there were two glasses on the table, one containing water and the other soda-water. The immediate cause of death was syncope from heart disease.

5.—Prince Osman Fazil, cousin of the Khedive, died suddenly of apoplexy (Daily Paper, 19th Feb., 1898).

6.—Alphonse Daudet. "He was seated at dinner . . . when he was suddenly seized with an attack of syncope and died" (*Times*, 17th Dec., 1897).

7.—Mr. R. C. Hale, Alderman in the city of London; was in full health and activity up to Friday, but died that day from heart failure (Daily Paper, 27th Dec., 1897).

8.—Mr. Charles Harrison, M.P., died from a very sudden attack of laryngitis and failure of the heart (*Times*, 27th Dec., 1897).

9.—Dr. Leonard Remfry, distinguished physician, died suddenly at the early age of thirty-seven (Daily Paper, 14th Feb., 1898).

10.—Dr. F. W. Barry, Senior Medical Inspector to the Local Government Board, died suddenly (*Times*, 13th Oct., 1897).

11.—Dr. Drechsel, a famous physiologist, died suddenly (*Nature*, 21st Oct., 1897).

12.—Commander B. R. T. Coward, of Newton Abbot, forty-five years of age, was suddenly taken ill and died within twenty minutes.

13.—Mr. George M. Pullman expired suddenly from heart disease (Daily Paper, 20th Oct., 1897).

14.—Prof. Humphrey died, thirty years of age (*Nature*, 16th Sept., 1897).

15.—Mr. du Maurier "has succumbed to heart trouble," sixty-two years of age (Daily Paper, 8th Oct., 1896).

16.—Mr. Francis Pattrick, M.A., "whilst dining with the Master of Trinity Hall, was taken with a fainting fit and died almost immediately" (Daily Paper, 8th Oct., 1896).

17.—Prof. Romanes died suddenly, aged forty-six (May, 1894).

18.—Hon. Roden Noel died from heart disease (May, 1894).

19.—Dr. J. H. L. H. Langdon-Down "died suddenly yesterday morning" (Daily Paper, 8th Oct., 1896).

20.—The Rev. J. H. Rose, M.A., at a meeting of the Clerkenwell Vestry, sank down in a faint and died within half an hour (Daily Paper, 29th April, 1898).

And how many cases, which can be counted by the thousand, remain unreported?

GLOSSARY OF SCIENTIFIC TERMS.

Adenoid (Greek: *aden*, a gland; and *eidos*, appearance).—Appertaining to a gland; glandular.

Albumen.—An organic compound containing nitrogen. Prototype: white of egg. It forms the principal constituent of all organic bodies.

Amnion Water.—The liquid which fills the space around the fœtus in the womb.

Angina Pectoris (Latin: *ango*, to choke; and *pectus*, the breast).—An anomalous and spasmodic affection of the chest, classed with heart diseases.

Apoplexy.—A sudden deprivation of all sense and voluntary motion. Apoplectic seizure, an attack of apoplexy.

Ascites (Greek: *askos*, a bottle).—Dropsy of the abdomen, or a tense elastic swelling of the belly.

Asthenic (Greek: *a*, without; and *sthenos*, strength).—Weak, debilitated. (See Sthenia.)

Atheromatous.—Like an encysted tumour; an atherome.

Atrophy (Greek: *a*, without; and *trepho*, to nourish).—A wasting of the flesh from the defect of nourishment.

Axillary.—Appertaining to the arm-pit, especially the glands of the arm-pit.

Bacillus (Latin: *bacillum*, a rod).—A form of bacterium of longish shape; hence the name, as distinct from the spherical bacterium, the *coccus*.

Bacteriology.—The science of distinguishing and cultivating bacteria, and investigating their influence on the human organism.

Bacterium (Greek: *bacterion*, diminutive of *bactron*, a rod or staff). Is synonymous with *schizomycetes* (Greek: *schizein*, splitting, and *mykes*, fungus).—An organism consisting of one cell, which multiplies by division.

Balneology (Latin: *balnearium*, a bathing room; and Greek: *logos*, a discourse).—The science of bathing, including the effect of mineral waters for medicinal purposes.

BASES.—In chemistry: mineral and other bodies, which, when combining with *acids*, form *salts* of various kinds.

BUTYRIC ACID (Latin: *butyrum*, butter).—An organic acid, formed from butter and from amylaceous nutriments through fermentation.

CAPILLARIES (Latin: *capillario*, relating to the hair), or *capillary vessels*—are the minute ramifications of the arteries and other vessels.

CARDIAC (Greek: *cardia*, the heart).—Appertaining to the heart; thus, cardiac failure, heart failure.

CARTILAGE (Latin: *cartilago*).—Gristle; a smooth, solid, elastic substance, of which the connective tissues, bands, cords, and the elastic (inter-vertebral) bodies of the spinal column are formed.

CASEIN.—An albuminoid substance, the principal constituent of cheese, as also of the milk of the mammalia.

CEREBRAL (Latin: *cerebrum*, the brain).—Appertaining to the brain.

CERVICAL (Latin: *cervicalis*).—Appertaining to the neck.

CHORDA DORSALIS (Greek: *chorde*, a string; and Latin: *dorsum*, the back).—The first form of the spinal column in the embryo of the vertebrates.

COAGULATION.—The act of changing from a fluid to a firm state; especially applied to the blood and lymph plasma of the animal organism.

COLLOIDS (Greek: *kolla*, glue; and *eidos*, appearance).—Substances like glue and albumen, which do not diffuse through parchment or porous membranes; as distinct from *Crystalloids*.

COMA (Greek: *koma*, a deep sleep).—A state of unconsciousness.

CONGENITAL (Latin: *congenitus*).—Of the same birth, *i.e.*, with or from birth.

CRASSAMENTUM.—The red clot of coagulated blood.

CUTANEOUS (Latin: *cutis*, the skin).—Appertaining to the skin. Cutaneous nerves: the nerves of the skin.

DIAGNOSIS (Greek: literally, knowing through).—The distinctive knowledge of a disease.

DIALYSIS (Greek: flowing through).—The passage of liquids, holding crystalloid and colloid substances in solution, through the interstices of porous membranes.

DIAPHORESIS.—The elimination of water from the body through the pores of the skin.

DIURESIS.—The elimination of water from the body through the kidneys.

DUODENUM.—The first of the small intestines, which receives the chymified food from the stomach, the bile from the liver, and the pancreatic juice from the pancreas.

EMBRYO (Greek: *en*, in; and *bruo*, to generate).—The first rudiments of an animal in the womb, before it is perfectly formed.

EMPHYSEMA (Greek: *en*, in; and *physa*, wind).—A puffy tumour; wind-dropsy.

ENCYSTED (Greek: *en*, in; and *kustis*, a bag).—Enclosed in a bag, bladder or vesicle.

ENDOSMOSIS (Greek: *endon*, within; and *osmos*, impulsion).—The passage of fluids inwards, through a membrane. (See also Dialysis and Exosmosis.)

ENTERIC.—Appertaining to the intestines. *Enteric fever;* a malady, the chief symptoms of which are manifested in the intestines.

EPIDERMIS (Greek: *epi*, upon; and *derma*, the skin).—The exterior coat of the skin.

EPILEPSY (Greek: *epilepsia*).—The falling sickness; so called, because the patient falls suddenly to the ground. A disease, accompanied with spasms or convulsions and loss of sense.

EXCRETA (Latin: *ex*, out; and *eretus*, sifted).—The substances, solids or liquids, thrown out of the body. Synonym, *excrements*.

EXCRETION.—The act of separating and discharging the excreta from the system.

EXOSMOSIS (Greek: *ex* or *ek*, out; and *osmos*, impulsion).—The passage of fluids outwards through a membrane.

FÆCES.—Excreta or excrements: the substances discharged from the body by way of the anus or rectum.

FAUCES.—The posterior part of the mouth; the cavity behind the tongue.

FEBRIFUGE (Latin: *febris*, fever; and *fugo*, to chase away).—Having the quality of mitigating or subduing fever.

FEMORAL (Latin: *femur*, the thigh).—Relating to, or lying near the thigh bone.

FIBRIN (Latin: *fibra*, a fibre).—A fibrous substance formed in the coagulation of the blood and lymph; it belongs to the albuminoids.

FŒTUS or FETUS (Latin).—The young of viviparous animals in the womb, after it is perfectly formed. (See Embryo.)

GASTRO-ENTERITIS (Greek: *gaster*, the belly or stomach; and *entera*, the bowels or intestines).—Inflammation of the digestive canal, *i.e.*, the stomach and intestines.

GASTRO-INTESTINAL.—Appertaining to the stomach and intestines.

GENEALOGY (Greek: *genos*, birth; and *logos*, a treatise).—An account of the descent of a person or family from an ancestor.

GLAND (Latin: *glans*).—A distinct soft body forming part of the animal organism, consisting of a convolution of a great number of vessels destined to some special function; mostly to secrete some fluid from the blood.

GRAM (French: *gramme*).—The unit of the decimal system of weights; it is equal to 15·43 grains; 28 (exactly 28·35) grams are equal to 1 ounce.

GYPSUM.—Sulphate of lime. Synonym, *calcium-sulphate.*

HÆMOGLOBIN (Greek: *haima*, blood; and Latin: *globulus*, a globule).—The colouring matter and oxygen carrier of the blood, contained in the red corpuscles.

HÆMOPTYSIS.—Spitting of blood.

HEPATIC DUCT (Greek: *hepar*, the liver; and Latin: *ductus*, a tube or canal).—The tube or duct which conveys the bile from the liver to the duodenum. It is also called CHOLEDOCHUS (Greek: *cholæ*, bile, and *dochus*, receiving).

HISTOLOGY (Greek: *histos*, a web; and *logos*, a discourse).—The science and microscopic study of animal tissue.

HYPERTROPHY (Greek: *huper*, over, in excess or beyond; and *trophe*, nutrition).—Excess of nourishment. Morbid enlargement of any part of the body.

HYPODERMIC (Greek, *hupo*, under, beneath; and *derma*, the skin).—Under the skin; applied to an injection; is synonymous with *subcutaneous.*

INCOMBUSTIBLE CONSTITUENTS.—The mineral substances which remain behind, when organic bodies are burnt.

ISOPATHIC (Greek: *isos*, equal; and *pathos*, feeling).—Appertaining to the principle of applying for the cure, the same or similar substance, which occasioned the disease. The principle is advanced in support of the serum treatment of disease, and is, or might be, considered as synonymous with *homœopathic* (Greek, *homoios*, similar), which term applies, to similar symptoms.

ISOTONIC (Greek: *isos*, equal; and Latin: *tonus*, sound—literally, increasing tension).—Of equal strength or tone for the animal system (as applied to the normal saline solution).

LACTIC ACID (Latin: *lac*, milk).—An organic acid, which occurs in milk and in the human stomach as the result of fermentation through absence or insufficiency of common salt.

LARYNX (Greek: *larunx*, the throat).—The upper part of the windpipe.

LESION (Latin: *læsio*).—Wound; injury.

LIQUOR SANGUINIS.—The fluid part of the blood which remains after removal of the blood corpuscles. It is also called blood plasma.

LITRE.—The unit measure of capacity in the decimal system. It contains 1000 grams of water, and is equal to about 1¾ (1·76) pints, or ⅞ quart.

MARASMUS (Greek: *marasmos*).—Atrophy; a wasting of flesh without fever or apparent disease; a kind of consumption.

MEDULLA OBLONGATA (Latin: elongated marrow).—The part of the central nervous system, which connects the brain with the upper part of the spinal marrow. It is supposed to be the central seat of life.

MESENTERY (Greek: *mesos*, middle; and *enteron*, the bowels).—A fatty membrane placed in the middle of the intestines, and to which these are attached. *Mesenteric*, appertaining to the mesentery.

METABOLISM (Greek: *metabole*, change).—The change in the composition or constitution of the body or its tissues.

METAMORPHOSIS (Greek).—Change of form or shape.

MORPHOLOGY (Greek: *morphe*, form; and *logos*, discourse, description).—The science of the internal and external forms of organic bodies, and of the origin, growth and change of these forms.

MYOSIN (Greek: *muos*, a muscle).—Muscle albumen. It is for the subject of this treatise of importance to state, that myosin is insoluble in water; but becomes soluble on the addition of common salt. This may have some bearing on the cause of rheumatism and the ameliorating effect of salt. (See Prof. E. Salkowski, *Ueber das Fleisch;* Virchow and Holtzendorf, *Wissenschaftliche Vorträge*, Heft 216, pp. 7-8.)

NECROSCOPIC (Greek: *nekros*, dead; and *skopeo*, to view).—Appertaining to post-mortem examinations.

NEPHRITIS (Greek).—Inflammation of the kidneys.

NEURILEMMA (Greek: *neuron*, nerve; and *lemma*, a sheath).—The sheath which envelops a nerve, or a bundle of nerves.

NEUROTIC.—Relating to the nerves.

NEUTRAL SALT.—A salt which has neither an acid nor an alkaline reaction. (Example: common salt.)

ŒDEMA (Greek: *oideo*, to swell).—A swelling of a dropsical nature; a tumour.

OS, PER OS (Latin: *os*, the mouth of man and animals).—By way of the mouth (administered—such as medicine or food).

OSSEOUS (Latin : *os*, a bone).—Bony ; resembling bone.

OSSIFICATION (Latin : *os ;* and *facere*, to make).—The process of forming bone; either normally in the child, or morbidly in adults.

PALSY.—Synonymous with *Paralysis*, which see.

PARALYSIS (Greek: *paraluo*, to loosen).—The loss of power, either wholly or only partially, of voluntary motion in the entire body or in any particular part.

PARENCHYMATOUS (Greek: *parenchyma*, the substance contained in the interstices between the blood-vessels of the viscera).—Appertaining to the parenchyma; spongy; porous.

PATHOGENIC (Greek: *pathos*, feeling, suffering; and Latin: *genero*, to beget, to produce).—Disease-producing.

PATHOGNOMONIC (Greek: *pathos*, and *ginosko*, to know).—Indicating that, by which a disease may be certainly known; characteristic of a disease.

PEPTONES (Greek: *pepto*, to digest).—Albuminous substances of food, after having been acted upon by the gastric secretion.

PERITONEUM (Greek: *peri*, around; and *teino*, to stretch).—The serous membrane, which lines the abdominal cavity and invests its viscera.

PLASMA (see Liquor Sanguinis) (Greek: *plasso*, to shape).—The fluid part of the blood, so named from the fact, that it contains the substances, from which the tissues of the body are built up.

PNEUMA (Greek).—Breath.

PNEUMON (Greek).—The lungs. *Pneumonic*, relating to the lungs.

PNEUMONIA.—Inflammation of the lungs.

PRÆCORDIA (Latin: *præ*, before; and *cor*, the heart).—The fore-part of the region of the heart.

PRODROMAL (Greek: *pro*, before; and *dromos*, running).—Fore-running; preceding.

PROTOPLASM.—(Greek: *protos*, first; and *plastos*, formed).—The nitrogenous substance, first and originally formed; the physical basis of all organic life. It is the essential constituent of all living beings, from the lowest form of cell, consisting of a simple lump of protoplasm, to the tissues of the most complicated and highest organised creatures.

PYÆMIA (Greek: *pyon*, pus; and *haima*, the blood).—Blood-poisoning.

PYRETICS (really: Anti-pyretics) (Greek: *pyrexis*, fever).—Medicines for the cure of fever; for lowering the temperature of the body in fever.

RETROGRESSIVE.—Going, or moving, or changing backwards.

RIGOR (Latin: stiffness, rigidness).—A sense of chilliness, with contraction of the skin; a convulsive shudder or slight tremor, as in the cold fit of a fever.

SALTS.—In chemistry, a number of bodies which are formed by the combination of acids with bases; in which process hydrogen in the acid is replaced by a metal or other radical base. (See, for further information, any good book on chemistry.)

SAPROPHYTES (Greek: *sapros*, decomposed; and *phuton*, a plant).—Fungi (*i.e.*, plants), which grow upon and obtain their food from decomposed plants and animals.

SCIRRHUS (Greek: *skirrhos*, hard).—A cancerous growth in which comparatively few cells are embedded in a mass of connective tissue. Appears mostly in the breast and in the stomach.

SECRETION (Latin: *se*; and *cerno*, *cretus*, to separate, set apart).—The process of separating from the blood substances, different from the blood itself, or from any of its constituents, such as bile, saliva, mucus, urine, etc. It also means the matter separated.

SEM. MED.—Shortened title of a French medical weekly publication: *La Semaine Médicale.*

SEPTICÆMIA (Greek: *sepo*, to putrefy; and *haima*, the blood).—The putrefaction of albuminoid substances and the formation of *Ptomaines* (Greek: *ptoma*, corpse), albuminous poisons in the human body, producing inflammation and fever.

SERUM.—The liquid part of the blood which remains, after the latter has been deprived of its corpuscles and its fibrin.

SERUM, *artificial.*—The French name for the normal ¾ per cent. common salt solution.

SERUM TREATMENT.—The injection of a diseased serum into the body of the patient, suffering from the same disease as that of the animal (mostly the horse), which was artificially infected and then bled, to obtain the serum. (See Isopathic.)

STHENIA (Greek: *sthenos*, strength).—A preternatural and morbid increase of vital energy, produced, as a disease, by abnormal excitability.

STROMA (Greek: *stroma*, the couch, the basis or foundation).—The body of the red corpuscles; it is of a spongy texture, the interstices of which contain the hæmoglobin.

SUBCUTANEOUS.—Under the skin; applied to the injection of serum. (See Hypodermic and Isopathic.)

SUBLIMATE.—Any solid substance, as camphor or sulphur, brought into a state of vapour by heat, and which, on cooling, returns again to the solid state. Specifically applied to *bichloride of mercury* (corrosive sublimate), a highly poisonous substance, which destroys any organic structure, with which it comes in contact.

SYNCOPE (Greek: *syn*, together; and *kopos*, a blow, a stroke).—A sudden attack of fainting; a "sinking together"; a breakdown of all bodily strength.

TABES (Latin: *tabeo*, wasting).—An emaciating disease, occurring in various forms. Consumption.

TELLURIC (Latin: *tellus*, the earth).—Appertaining to the earth; applied in reference to the influence which the earth (the soil?) has on the development and spread of epidemic and infectious diseases.

TISSUES (French: *tissu*, woven).—The texture or minute organisation of the various parts of the animal body.

TONSILLAR (Latin: *tonsillæ*).—Appertaining to a glandular body at the passage from the mouth to the pharynx (the upper part of the gullet or *œsophagus* (Greek: *oiso*, shall carry; and *phagein*, eating).

TRACHEA.—The windpipe.

UREA.—Is the ultimate metamorphic product of the nitrogenous constituent of the food, after its passage through, and its use by, the animal economy. It is the highest grade of oxidation; if remaining in the system it acts like a morbid poison to the organism, and is thus the cause of many diseases. Its expulsion by way of the kidneys depends—as one of the factors for that process—upon a sufficient supply of common salt to the system.

URIC ACID.—Is a nitrogenous compound, forming an intermediate stage in the metamorphosis of the albuminoids. By a further oxidation it is converted into urea. For its elimination from the body it requires common salt, with which it forms a crystallisable compound. Under abnormal conditions it forms deposits, especially on various joints (*synovia*—joint grease—being rich in albumen), and is thus a concomitant, if not the principal symptom of gout. An insufficient supply of common salt to the organism produces the various conditions for the formation, the retention and the deposition of uric acid in the body; but salt taken with food alone cannot act as a prophylactic.

VASCULAR SYSTEM (Latin: *vasculum*, a vessel).—The system of vessels, tubes, etc., in the animal organism. The circulatory system—such as the blood and the lymphatic system.

VERTIGO (Latin: *verto*, to turn).—Dizziness or swimming of the head.

VISCERA (Latin, the entrails).—A term applied to all the organs contained in the body.

VISCOSITY.—Glutinousness; that quality of soft substances, which makes them adhere so as not to be easily parted.

DECIMAL WEIGHTS AND MEASURES MENTIONED IN THE PRECEDING PAGES.

1 gram equal to 15·43 grains.

28·35 grams equal to 1 ounce.

1 kilogram equal to 1000 grams, equal to 2·2 lb.

1 litre of water weighs 1 kilogram, *i.e.*, 1000 grams, and is equal to 1·76 pints or 0·88 quart.

When will British legislators grasp the beauty and simplicity of the decimal system of weights and measures, and be induced to introduce it into daily use in the British Empire?

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3

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Salt [illegible] not only dissolves the organic
[illegible]
[illegible] the body of [illegible]
[illegible] the circulation through the [illegible]
which the transformation occurs.

Salt — [illegible] enters the blood & [illegible] the
body
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For ordinary bath [illegible]

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